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A Mexican Transmission Plant

The JOURNAL OF ELECTRICITY

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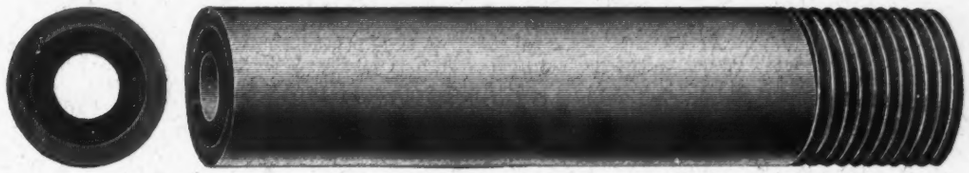

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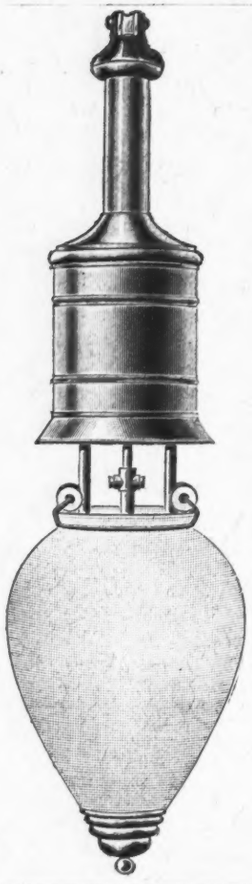

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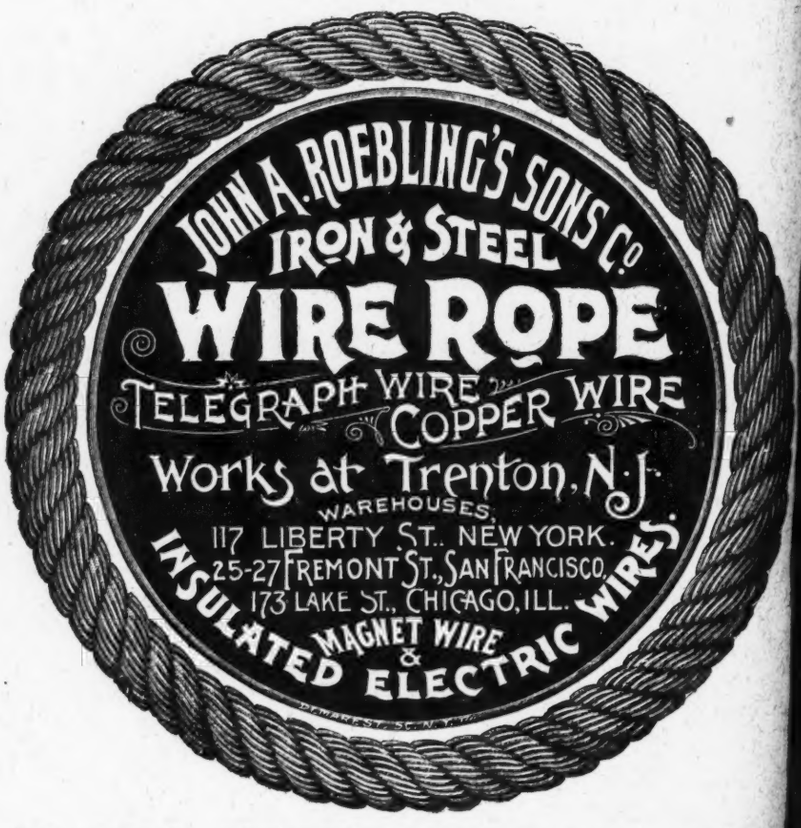

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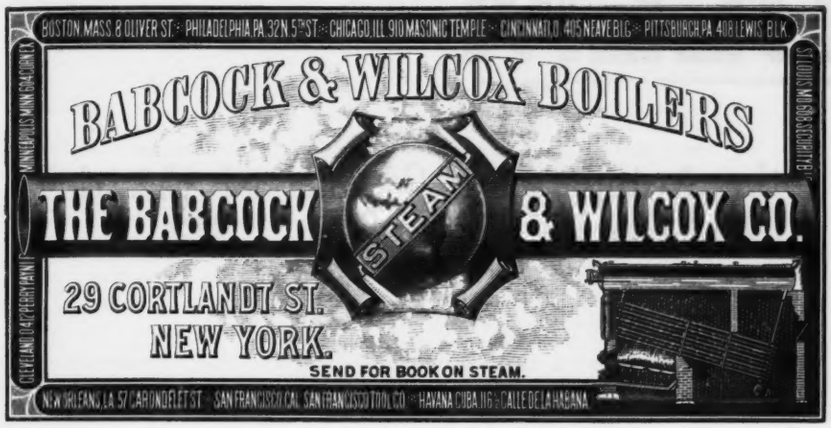
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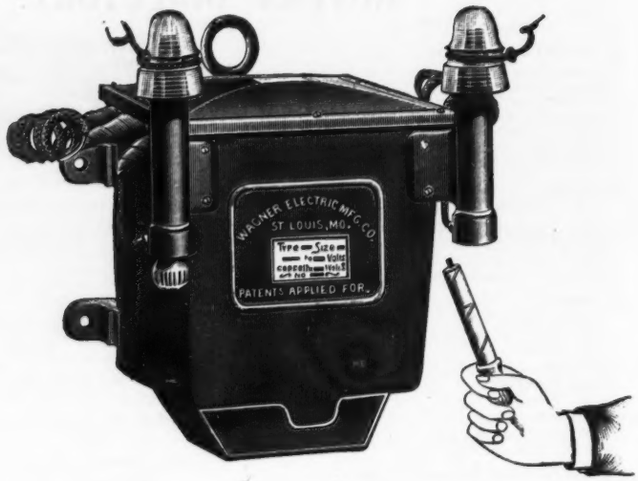

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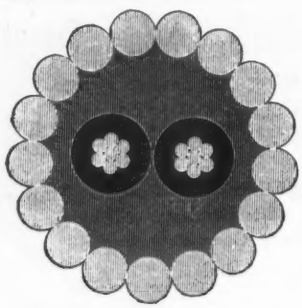

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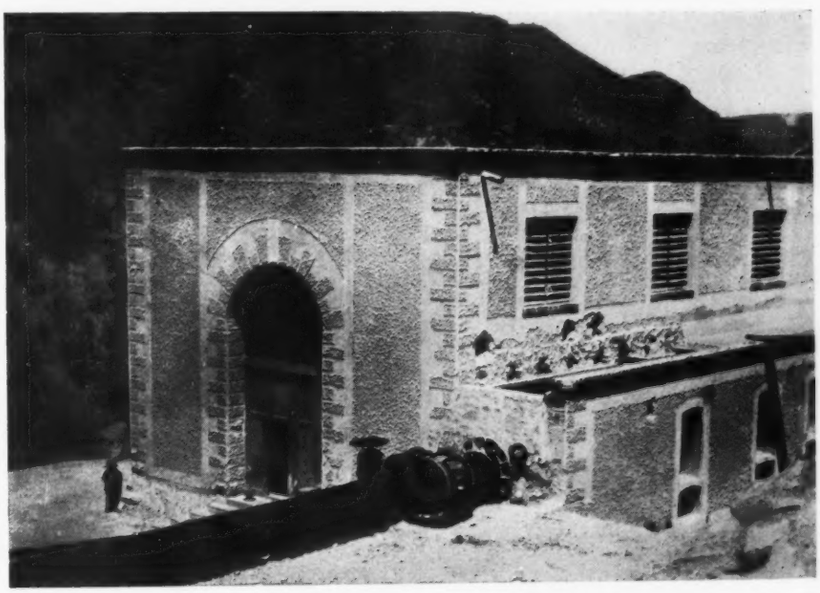
VOL. II. MAY 1896. No. 5

A Mexican Transmission Plant

BY GEORGE J. HENRY, JR.

In the State of Hidalgo in Mexico, there is now being erected one of the most modern and thoroughly equipped hydraulic electric power stations for the long distance transmission of power that modern engineering genius can devise. The excessively high price of fuel in the mining district to which power is to be furnished, and the large quantities of power necessary for pumping and to drive the old Chilian mills, will probably make the scheme so fine a financial investment as to give hydraulic electric transmission a great impetus throughout Mexico. In fact, the outcome of this project is now being watched by the engineering profession of the whole Republic.



POWER HOUSE OF THE HIDALGO TRANSMISSION PLANT

The Cia. Anonima de Transmission Electrica de Potencia has located the scene of its operations in the State of Hidalgo, about 100 miles north of the City of Mexico. The water is taken from the Arroyo de Regla, a mountain stream having a minimum supply of 1500 cubic feet per minute. A natural rock dam at a favorable point in the canyon, impounds the water sufficiently to admit of its being diverted by a cut through the bluff into a canal which follows mostly the contour of the mountain a distance of 1½ miles, a work which involved the cutting of seven tunnels, aggregating a total length of 1200 feet, through solid rock of hard volcanic formation.

Situated some 17 miles from the mining country is located the power house which is illustrated herewith. The site chosen is at the foot of a very precipitous gorge over 1000 feet deep and reached only by trail. From the terminus of the canal the water is carried to the power station through 1700 feet of 30-inch pipe, which affords a means of easily obtaining a head of 800 feet by running a tunnel, which, though short, proved very expensive to construct, because of its running through the very hardest of volcanic rock. The pipe line discharges into a receiver which is 40 inches in diameter by 75 feet long and made of three-quarters-inch sheet steel. The receiver was tested to 700 pounds hydrostatic pressure and weighs upwards of 50,000 pounds. Hydraulic valves and cylinders operate gates for each of the water wheels used and everything is installed with a view to the most simple and easy operation. The power station consists of two 24-inch Pelton exciter wheels running at 1700 revolutions per minute, and five Pelton water wheels, each 43 inches in diameter, and having a capacity of 600 horse-power. Directly connected to each of four of these 43-inch wheels is a 12-pole, 300 kilowatt, 500 volt, 3-phase General Electric generator, running at a speed of 600 revolutions per minute and delivering current to a bank of six transformers, a seventh being held in reserve, two transformers being included in parallel in each leg of the 3-phase circuit. Before reaching the transformers, however, the 500-volt current is taken through a very handsome and complete switchboard, where it is equalized on a set of three buss bars.

The transformers deliver current to the transmission

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lines at 10,000 volts, after having gone through the high potential switchboard ammeters and break switches. The line consists of three 0000 B. & S. copper wires, supported on double petticoat porcelain insulators. There are to be three step-down transformer stations located at the most convenient points along the line, which will give low potential current to the induction motors to run the pumps and mills. All transformers are of the air blast type.

This transmission plant is to supply power to the mines of the Rio del Monte Company, one of the most extensive mining organizations in the world, employing upwards of 8000 men. The power is to be used for operating mining machinery, such as stamp mills, crushers, pumps, hoists, ventilators, etc., etc. The mines of this company—said to be the richest in Mexico—are located within a radius of 20 miles, the maximum distance of power transmission being 23 miles, and the mean distance about 18 miles. Various other mines in the vicinity will also be supplied with power from this station, and the city of Pachuca also furnished with light. A market for the entire power of the plant being thus afforded at highly remunerative rates. the financial success of the enterprise is assured; in fact. it is claimed that the entire outlay, some three hundred thousand dollars, will be returned to the company in two years' time, by the saving effected in fuel heretofore required in carrying on their various operations.

Considering the magnitude of the work, the great water pressure, the variety and extent of machinery to be operated. as well as the difficulties attending the transportation and erection of such massive machinery in a mountainous and almost inaccessible region, this may be regarded altogether one of the most remarkable electric power installations so far made in any part of the world, with the single exception of the 35-mile transmission plant of the San Joaquin Electric Company of Fresno, Cal.

Mining

THE NUCLEUS OF A GREAT TRANSMISSION PLANT.

The Utica Mining Company of Angels Camp, Calaveras County, annually produces between five and six million dollars worth of gold, which is the largest output of any of the gold mines in California, and at present all the power consumed in the operation of the mine, except that for lighting, is obtained from steam, which is very expensive owing to the high price of fuel. It was therefore deemed advisable to derive experience in the application of electricity for lighting and power purposes before making the expenditures that would be necessary for the installation of a plant of such magnitude as would satisfy the company's requirements. Accordingly in January, 1895, the small plant now described for the first time was erected, first in order to secure satisfactory lighting at the most reasonable cost, and second, that greater familiarity with electricity might be obtained not only by the management, but also by the miners themselves. Though this original plant is simple in the extreme it has fulfilled its purposes and will shortly be superseded by one of the largest mining installations in the world.

FIGURE 1—ORIGINAL POWER HOUSE OF THE UTICA MINING CO.

FIGURE 2—INTERIOR OF POWER HOUSE OF THE UTICA MINING CO

The company owns the water power of 2000 miners inches of water secured from which is obtained a fall of 570 feet in 1750 feet of pipe line. The present electrical plant uses about 150 inches of water of the 3000 horse-power available. The power derived from a 6-foot tangential Dodd wheel is belted to a 1,500-light 2,500-volt Westinghouse alternator, whence the current is carried over a circuit of 1 B. & S., guage, bare copper wire to the mine situated about 1,000 feet below the plant, where it is used for lighting purposes, there being 25 alternating current constant potential arc lamps and 1,250 incandescents. The exciter is driven by a separate 12-inch Dodd wheel.

It has been practically decided that during the coming summer the large installation referred to will be undertaken, when 3,000 horse-power will be generated and transmitted to the mine and thereabouts. The length of transmission will be about 8½ miles and the system will consist of 2-phase generation, 3-phase transmission and various distributions. Five hundred horse-power will be utilized in air compression, two 60-stamp mills will require 150 horse-power each, and one, 250 horse-power rotary transformer will generate low potential direct current to be used for power purposes down the shaft. Six 500 horse-power units to operate in parallel or singly, as deemed advisable, will be installed and the transmission will be at 10,000 volts. In addition to the purposes named, two sawmills, together with machine shops, rock breakers, etc., will be operated by electric power. The apparatus used will be that of the Westinghouse Electric & Manufacturing Co., throughout.

Electro-Therapeuty

THE SCIENTIFIC APPLICATION OF ELECTRICITY IN MEDICINE.—III.

BY W. N. SHERMAN, M. D.

Static or Franklinic electricity has become one of the most useful and favorite methods in electro-therapeutics. There has been great mechanical improvement in the various static machines of late years, and it is no longer necessary to employ extra apparatus for charging the machines as the best of them pick up their charge quickly and begin to generate a current at once, and will when properly cared for work nearly every day in the year regardless of the climate.

The Atkinson-Topler static machine, made by the McIntosh Company of Chicago, is the best of any I have used and affords a variety of currents according to the electrodes use. The static induced current is similar to the Faradic current and may be given without removing the clothing, as may also the static bath and breeze, the direct and indirect spark, the localized spray and static insulation.

These various methods of application may be used as indicated in each particular disease or ailment and afford a pleasant and effectual method of treatment in many diseases. Owing to its high electro motive force (60,000 to 100,000 volts at ordinary speed and giving a one-inch spark) the static current readily overcomes the resistance of clothing skin, and reaches the nerve centers in a remarkable manner. Any good static machine may be used in a very satisfactory manner for producing Roentgen or "X" rays, and when connected to a Crooke's tube a three or four-inch spark is usually sufficient, but the tube should be of higher vacuum than when used with the induction coil. Galvanic, static and Faradic electricity in the order named are of most frequent use in electro-therapeutics. The sinusoidal current is yet new, but may in time prove as efficient as any of the other forms.

I shall conclude by mentioning a few other applications of electricity used mostly in surgical work and for motor and illuminating purposes, the source of the current with few exceptions being from two or more storage cells. The surgical uses of the continuous or galvanic current properly come under four divisions, viz: chemical, physical, illuminating and motor. Under the first head should be placed electrolysis, as practiced in the removal of hair, the destruction of facial blemishes, such as naevi or wine marks, erectile tumors, aneurism, goitre, piles, strictures, etc. For such operations from six to eight volts from small primary cells, and from three to five milliamperes of current are used.

For cautery purposes, such as the heating of small platinum knives, wire, etc., a current of great quantity (75 to 100 amperes) is used with a small potential of from 4 to 6 volts supplied by secondary or storage cells. The same current is used for small incandescent electric lights for the examination of the internal organs such as the bladder, the stomach, and other cavities. These methods of introducing small lights into the human body afford an effectual and convenient method of diagnosis in many diseased conditions. In the throat, nasal and post nasal cavities, these electric lamps are made so as to fit into the same cautery handle as is done with the small cautery knives used in nose and throat work. In the amputation of certain soft parts, such as the tongue, the hot platinum wire is far superior to other methods, as it is clean, and affords an almost bloodless means of operating. This method is often used for small amputations of vascular organs, tumors, and soft growths, leaving as it does a clean, bloodless stump which heals quickly. With energy from the same source as that used for cautery and illuminating purposes, one is enabled to run a surgical engine with flexible cable and drills for removing exostoses in the nasal cavities and elsewhere. It is convenient for running the static machine when connected by belt to a small motor, also for winding bandages in the operating room, for rotating a centrifuge and for other mechanical work.

A word about electric belts. Physicians who understand electricity do not use or recommend them because they are worthless. I have never seen an electric belt that would indicate one milliampere on a short circuit. Then let me ask what effect would such a belt have on the highly resisting surface of the human body?

ERRATA.—Through inadvertance, the authorship of Part II. of the serial that has recently been published on "The Scientific Application of Electricity in Medicine" was ascribed to "W. N. Williams, M. D.," whereas the article should be credited to W. N. Sherman, M. D.," to whom sincere apologies are extended.

A MONOCYCLIC DISTRIBUTION PLANT.

One of the most interesting modern stations in this country, and the first, perhaps, which has a larger motor load than a lighting load, is that at Middletown, Ohio, operated

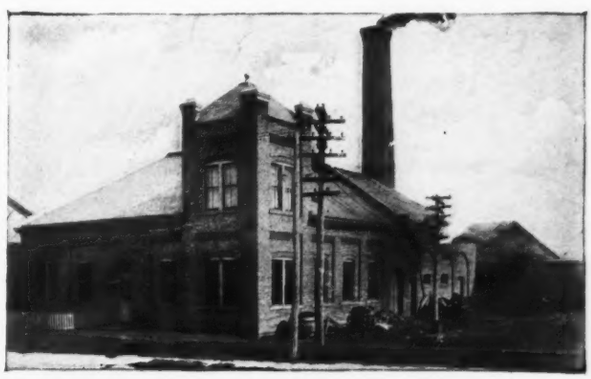

FIGURE 1—GENERATING STATION, MIDDLETOWN, O.

by the Middletown Electric Light and Power Company.

It is now some four months since Mr. E. H. McKnight, president and general manager, determined on an increase in his station, which up to that time had operated on a small scale only. The conditions with which he was confronted showed the necessity for a system of distribution which would allow him to cope with a large demand for current for motor service during the day and a similarly large one for lighting after dark. As best satisfying these conditions, Mr. McKnight selected the Monocyclic system of the General Electric Company.

The power house is large and well ventilated and is situated near the center of the city in an ideal location for an electric station. It fronts on the Cleveland and Cincinnati Canal, while immediately behind it are the tracks of the M. & C. Railroad. Water for the station is taken from the canal in front and the necessary coal is shoveled directly into the bins from the cars standing on the tracks behind.

The steam equipment consists of two Brownell and Dayton boilers, furnishing steam to one 250 h. p. Russell engine and one 100 h. p. Ball engine. The first runs at 164 revolutions and drives from a countershaft the new monocyclic generator and two T. H. 75 light arc dynamos; the

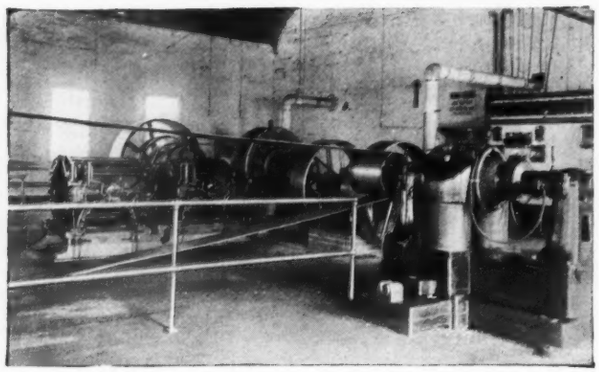

FIGURE 2—INTERIOR GENERATING STATION, MIDDLETOWN, O.

latter runs at 285 revolutions and drives a D-62 T. H. bipolar direct current low voltage machine. The monocyclic generator is a standard 12 pole machine, running at 600 revolutions. It is rated at 150 k. w. at 1040 volts, and is excited by a 1½ k. w. exciter. The D-62 furnishes current for direct current motors scattered throughout the city. The arc machines operate lights in the streets, while the monocycle is wired for about 180 horse power in motors and 2000 lights. If all the lights and motors were operated at the same time the total amount of energy required from this generator would be about double its capacity and its power to cope with the conditions illustrates forcibly the advantages of the monocyclic system. During the day the lights burning are comparatively few, while the motor load is at its maximum. This condition is reversed after dark, when the motor load drops off and the lighting load rises in turn. The generator, which runs 23 hours per day, is worked continuously at its highest efficiency and satisfactorily fulfils its double duty without sparking or noticeable heating.

With service of this severity, deterioration in the performance of the machine would naturally be expected. Yet, it has been running for about three months under these onerous conditions without a minute of lost time from any cause whatsoever.

The regulation of the machine is noteworthy, the voltage remaining almost absolutely constant. The lights at a large factory, about a mile away, and those throughout the the city, burn with equal brilliancy, and the throwing on or off of the motor load is accomplished without flickering or variation of the intensity of the light. In fact, the presence of the motor load is usually only determined by examination of the ammeter. This perfection of regulation is attained by placing the stationary shunt of the alternator in a certain position in the morning, and leaving it thus during the day, while the induction motor load dominates. At night when the lighting load is the heavier, the only change necessary is the advancing of the stationary shunt about one inch. No care beyond this is needed to maintain a constant potential—the machine apparently takes care of itself.

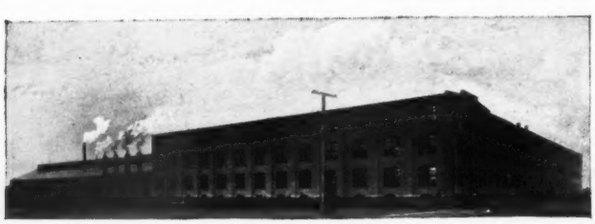

FIGURE 3—MIAMI CYCLE & MANUFACTURING CO.'S PLANT

The most important client of the Middletown station is the Miami Cycle and Manufacturing Company, whose factory is located about one mile distant. It takes current for 180 horse-power in motors; for 800 incandescent lamps, of which 400 are usually in use, and for six arc lamps. The cycle company turns out about 200 wheels a day, and employs from 500 to 600 hands. It manufactures an extremely high grade bicycle, the assistance to this end which electric service renders.

The current is transmitted from the station to the works over two mains and a teasor wire at about 1000 volts, and is reduced to about 115 volts in six 30,000 watt oil-cooled transformers installed in a small house erected in the angle of the L-shaped main building. All the mortors derive their supply of current from these transformers connected to multiple. The lighting circuits are taken off from two 7500 and one 15,000 watt transformers. The primary wires from the station are passed through a station watt meter just before they arrive at the transformers, and thus the consumption of energy in both lightning and motor circuits is measured in one instrument.

The secondaries run from the small sub-station north and

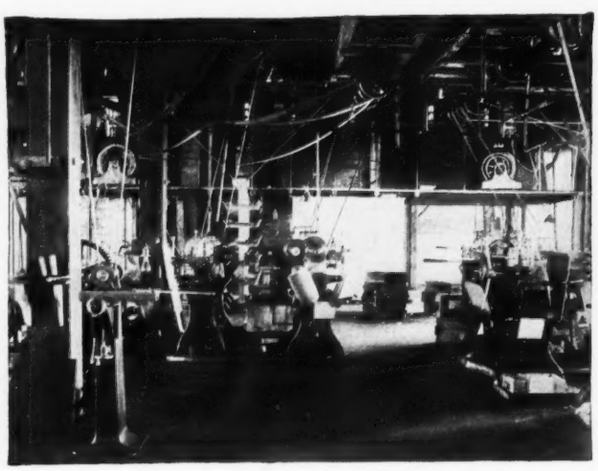

FIGURE 4—CORNER OF MACHINE ROOM, SHOWING INDUCTION MOTORS

south to the motors and lights in the two legs of the L. Those running south operate in the machine shop 3 20 h. p. motors, each belted to a long line of shafting from which run 80 belts. One of these motors is used to drive 15 lathes, 4 sharpers and 6 milling machines; 3 water emery wheels, 1 planer, 1 die sinker, 2 universal grinders, 2 gear cutters, and 2 drill binders. The other two operate 35 screw machines, 1 oil separator, 1 oil pump, and 2 high-pressure blowers, giving air to the forges in the smithy.

The feeders running north supply energy to three 30 h. p. motors, two of 10 h. p. and two of 5 h. p. One of the 10 h. p. motors is in the drill room and runs a shaft from which belts run to 12 large and 3 small drill presses, 2 cone grinders and 4 small milling machines. In addition, it operates 1 band saw, 1 circular saw, and 1 wood turner's lathe in the pattern room adjoining. The other 10 h. p. motor is in the Frame Making Department and drives 3 large punch presses for the manufacture of handle bars, seat posts, etc., 3 large drill presses, 4 small ones, 2 frame assembling tables, 3 small milling machines, 2 emery grinders, 1 swaging machine, 4 stock machines, 2 tooth cutters, and 1 double-polishing lathe.

A large portion of the power which comes into the factory is used in the Polishing Room, where 35 double-polishing lathes run incessantly. Those are operated at present

by two 30 h. p. motors. The remaining 30 h. p. motor in the north section drives a 48-inch exhaust blower, which carries away the dust from the Polishing Room.

Located in the Assemblying Department is a 5 h. p. motor, which operates a freight elevator of 1500 lbs, at 60 feet per minute capacity through the room. When this was put up it was thought that a larger motor would be required to move up and down the occasional heavy loads, but the 5 h. p. motor not only operates the elevator satisfactorily, but also has sufficient power left to drive 5 small drill presses. The other 5 h. p. motor drives a 4 k. w. C. & C. generator used for plating purposes.

All these motors are of the General Electric Induction type, without commutator, collector or moving contracts. They are set up on platforms swung from rafters in the rooms, an arrangement rendered possible by the fact that they require no attention beyond an occasional oiling, and thus occupy no floor space whatsoever.

The introduction of the induction motors into these works was the result of pure conversion. Skeptical at first, the company, willing enough to allow a trial, permitted the installation of a 20 h. p. motor as an experiment.

FIGURE 5—MACHINE ROOM, SHOWING MACHINERY DRIVEN BY MOTORS

It reached the factory in September, 1895, was put into service in the Machine Room and ran the machine for the night shift. The experiment was as severe a test as could well be imagined for a motor. It ran over 300 feet of 3-inch shafting, 172 belts, 5 screw machines and 17 other machines such as drills, lathes, etc. The usual course was to add machine after machine until the motor stopped. One or two would then be thrown off and under an excessive overload which brought it within the reach of breaking down, the motor continued to run for its shift of ten or twelve hours. No accident happened to it during the two months this course of treatment continued. Its missionary work was successful. It was purchased by the cycle company, which ordered eight others at once, to be sent by express. Their factory could not be equipped electrically too soon for them. The constant speed of the machinery has enabled them to turn out a wheel with workmanship of peculiarly high quality, and its success has compelled them to enlarge the works, which are entirely lighted with lamps taking current from the monocyclic generator.

In addition to the load at the Miami Cycle Works, the monocyclic generator supplies current to 500 to 600 lights throughout the town, and 650 incandescents in the Sorg. Opera House. With 50 h. p. in motors and 400 lamps

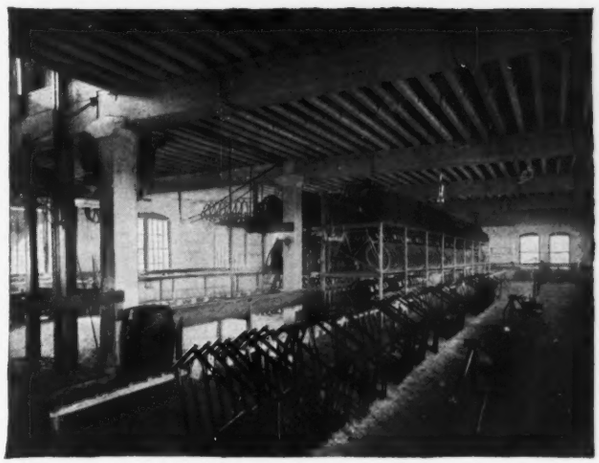

FIGURE 6—PART OF ASSEMBLING ROOM, SHOWING MOTOR FOR ELEVATOR

burning at the cycles works, and as many in the city, the lights in the Opera House burned brightly and without flickering.

The description of this noteworthy plant, the success of which is due to the able management of Mr. McKnight, may fitly be concluded with his own remark, "In all particulars, it surpassed my most sanguine expectations."

UTILIZING WASTE POWER ON RAILROADS.

A straw which points to the future development of a remarkable source of economy in freight railroad traffic is the utilization of the weight of the freight which is proposed on a new road in Northern Michigan. The road runs from Lake Superior fifteen miles inland to the mines, and in this distance the total grade amounts to a rise of 800 feet. The freight will be almost entirely iron ore, which is brought down in special cars, which are returned empty to the mines. The cars will be run in trains of ten each, each train being supplied with an electric generator, connected with the axles. The grade is such that the loaded cars run by their own weight, and the dynamos generate a current, which is taken off upon a trolley wire and used to haul the empty cars back. It is thought that the difference in weight of the loaded and empty cars will give power enough to overcome all leakage, friction, etc. The engineers are figuring on using the dynamos as motors on the return trip, and thus saving expensive machinery. The experiment will be awaited with interest.

FIGURE 7—ASSEMBLING ROOM

THE JOURNAL OF ELECTRICITY.

An Illustrated Review of the Industrial Applications of Electricity, Gas and Power.

EDITED BY

F. A. C. PERRINE, D. Sc., and GEORGE P. LOW.

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EDITORIAL.

LIGHTNING ARRESTERS IN CALIFORNIA

The history of electric undertakings during the past two years has sufficiently proven the folly of installing overhead electric lines upon the Pacific Coast, and particularly in California, without the use of lightning arresters. The neglect of this means of protecting electric circuits we believe has come partially from a misunderstanding of the conditions of the climate and partially from a lack of understanding of the functions of a lightning arresters. The idea that arresters arrest when the line has been struck is erroneous, for, as an eminent authority has said concerning lightning strokes: "It is rare that an overhead electric line is directly struck by a lightning flash, but when this does actually happen, there is but one remedy; to trust in Providence and repair what is left of the station." Lightning arresters do not, therefore, serve as conductors in the case of a flash striking the wires, but do allow an easy adjustment of potentials upon the line whenever a lightning stroke has occurred anywhere in its neighborhood. A flash of lightning is a discharge between oppositely electrified bodies, which may be two different clouds or a cloud and the earth; in any case the potential of the surrounding atmosphere is reduced to that of the earth, or to zero, and there is a tendency for all bodies in the neighborhood which have been electrified, either directly from the charge of the clouds or by induction at the time of the flash, to discharge themselves. An electric line finds itself at the time of every lightning discharge in its neighborhood in the condition of a charged body at a different potential from that of the earth, and unless we provide some easy path for the charge of the line to be reduced to the potential of the earth, the insulation will be pierced and the charge will find its own path to the ground. On account of the high self-induction of a portion of the machinery of the station the two opposite sides of the line will separately discharge themselves and the dynamo current following the static spark a disastrous short circuit will result unless a lightning arrester is provided for overcoming this difficulty. It is at once seen that even a rare storm and rare flash of lightning may occasion much damage in an electric station because an electric line must discharge itself, nor merely in the unlikely condition of its being struck, but at every time there is an electric discharge in its neighborhood. Simple lightning arresters are not expensive pieces of apparatus nor difficult to care for, whereas, the damage that has been done in California during the past two years to the apparatus of those who have relied upon a traditional immunity from lightning strokes would have paid many times over for a complete equipment of all California stations with efficient lightning arresters.

ECONOMY MUST FIT THE LOAD CURVE

To the engineer familiar with English practice, either through experience or through the knowledge of their literature, it is very striking to find that in the United States comparatively little value has been placed upon experiments made with steam generators, and of no class of steam generating plants has this been truer than in those connected with electric lighting stations.

In England, we find the old Lancashire and Cornish boilers giving good service, and at the same time extensive use is made not only of the "return tabular," but also of the "water tube" boiler, while in the United States no attention has been paid to any type except the "return tubular," unless the type has been patented and extensively advertised by a manufacturing company. In other words, American engineers seem to depend less upon their own experience than upon the claims made by others and upon single sets of experimental trials. In electrical engineering this is not only due to the fact that only a very limited number of engineers have the time and experience necessary for designing a special boiler plant to perform a special service, but also it is due to the fact that the generation of steam in an electrical supply company demands that the particular location of the station should be considered as well as the economy to be achieved. Where the station is placed in the heart of a city, it is not possible to install boilers of unlimited size, nor is it possible to risk accidents from untried systems of construction, and therefore our engineers are in the main to be commended for an extreme conservatism in installing under such circumstances only those types of steam generating apparatus which have been tried and proved entirely reliable and at the same time with the increase of loads and the multiplication of competitive plants as well as the experience that has been gained in high potential transmissions. American engineers are finding a new set of conditions which not only require a restating of the problems of efficiency, but also allow the possibility of individual experimentation.

We are too much disposed to rely upon efficiency tests at full load, while the efficiency of a station depends upon the efficiency at an exceedingly variable load, and if we can develop a boiler plant which shall furnish a pound of steam with a reasonable amount of coal, considering the day as a unit of time, rather than the period of full load, we will solve the problem that now presents itself before electrical engineers of reducing an outrageously extravagant coal consumption that is noticeable in all of our central stations.

It is time for a reaction to set in against high efficiency apparatus, both steam and electric, which is only capable of giving high efficiency at maximum load, and it is time for central station engineers to consider more carefully than they seem to have done in the past, the average efficiency of their central stations' plant. We now point out particularly the boiler plant as a fundamental part of electrical generation, particularly because this part of the plant has been neglected by individual engineers, no matter how carefully it has been investigated by the engineers of special boiler types.

CHEMISTRY IN WATER POWER DEVELOPMENT

One of the most serious of the problems which face the projectors of water power transmissions in California is set by the great fluctuation in the amount of power available at different times of the year. Either only so much machinery must be installed as can be driven at the period of minimum flow of water, great reservoirs for water storage must be provided, or, it will be necessary to obtain some load that will utilize the surplus of power during the periods of maximum flow. Installing the minimum amount of machinery in many cases seriously limits the capacity of the generating plant; to build great reservoirs for water storage will entail an enormous expense and produce interest charges, greatly diminishing the advantage of water power transmission over the production of a similiar amount of power by coal consumption, while it is hardly possible to expect that the users of power will install duplicate steam and electric apparatus in order to obtain the advantage of low power charges during the maximum flow period.

The only feasible plan for using the power during this period of maximum flow seems therefore to be by some manufacture that can be economically carried on in seasons and not through the whole year. Such manufactures may easily be found in the field of electro-chemistry. It is rumored that the proprietors of the plant at Folsom, Cal., are contemplating the installation of a plant for the manufacture of calcium carbide during this period of maximum flow of water and an extension of this principle to many of the processess of electro-chemistry seems to contain the best possible solution of this vexed problem.

At the present time copper refineries are established throughout the United States which do not run throughout the entire year; the production and storage of bleaching salts, of chloride of potash, as well as of calcium carbide, do not seem to present insuperable difficulties, provided the power for their production can be obtained with sufficient cheapness, especially as in many cases the period of the minimum flow of water is only of short duration and the consequent accumulation of stock for the shut-down period will not be much greater than is at present provided for by the copper plants above referred to, by glass manufacturers and by others who are already in successful operation throughout the world. Indeed, we are bound to consider that the field of electro-chemistry is a very important one in the development of electric power throughout California since there is no doubt but that the amount of water power available is far in excess of any possible manufacturing demands for years to come, so far as the simple power used in the factories is concerned, while the cheap production of bleaches, dyes, acids, and other chemicals that must be brought from the East or from abroad, before great manufactories can be established, is of greater importance in the cost of the manufactured product than is the expense of coal simply for driving the machinery, and the successful establishment of many great manufactories west of the Rocky Mountains will surely depend as much upon a cheap supply of these necessary supplies as it will upon the availability of cheap power from long distance transmission.

THE G. E. CO'S ANNUAL REPORT

The fourth annual report issued by the General Electric Company from Schenectady under the date of April 18th will be anxiously examined alike by the friends and foes of the corporation to determine if possible the elements of strength or weakness within this great electrical organization.

The year has been one of many disasters in all fields of business and the common depression has been felt by the General Electric Company, as no doubt it has been felt by its rivals as well. The presence of a clear manufacturing profit upon the business taken for the year shows that the period of illegitimate business speculations has been past forever by electrical manufacturing concerns, and that this can be so is a matter of congratulation not only to those interested in the particular company under consideration but to all financially concerned in electrical enterprises. At the same time the period of past speculation is hard to live down and we find in the report material items of unprofitable investments which cannot be reassuring to the stockholders of the company.

Considering first the income above the expenses of running the company by themselves, we find it placed at $1,388,000, which amounts to a little more than 4 per cent upon the entire capital stock of the company, and while this effectually disposes of the claims which have been made that the company was in a bankrupt condition, the earnings can hardly be said to be satisfactory from the standpoint of an investor who is at all familiar with the expenses of operation of an industrial company, since the amount written off against the factory plant, in order to obtain these balances, does not amount to as much as 1 per cent of their valuation.

Looking now at the company's report, in order to deter-

mine, if possible, its value as a property, we find that almost $14,000,000 of the company's capitalization is not accounted for by any assets, in spite of the fact that the patents and franchises, earning $585,000, are valued at $8,000,000, and the stocks, bonds and notes, earning $421,000, are valued at $12,000,000. To be sure, it is impossible to estimate the actual value of the stock of this company from such a balance sheet, but we can conclude from its perusal at once that the capital which has been involved in the formation of the company does not earn as much as would be expected from ordinary industrial investments, and while the capital stock may be valued at anywhere from 30 to 60, it can hardly be given a higher valuation by the most enthusiastic admirers of the management, while there is no doubt that the condition of the company contains all the elements of a financial disaster and to bring it from its present condition of an unsatisfactory investment into that of its former great favor will require financial ability not hitherto shown by its managers.

There is no doubt but what the General Electric Company will live for many years to come, and that it will partake in the next wave of prosperity that may sweep over the country, but it can never again take the commanding position held from its origin until the crash in 1892, nor will it ever again be enabled to disturb and destroy business as it was accustomed to do in the past.

Passing Comment

AN EDITORIAL REVIEW OF CURRENT EVENTS AND PUBLICATIONS OF OUR CONTEMPORARIES.

ARE TELEPHONE COMPANIES COMMON CARRIERS?

An interesting legal point has recently been brought up in a suit entered by the Norwalk Telephone Company against the Central Union Telephone Company, in which the Norwalk Company demanded the right to use the toll lines of the Central Union Company for the transmission of the Norwalk Company's messages, the claim being made that a telephone company is a common carrier and consequently is obliged to transmit messages at a reasonable toll rate, in spite of the fact that they originate on the wires of a competitor. The case is fully described in an article published in the "Electrical Review" for March 4th. In this connection should also be noted a decision recently rendered, compelling the Western Union Telegraph Company to turn messages of a customer over to the Postal Telegraph Company on an order from the customer, and should the same position be held by the courts in deciding the telephone case we have cited, a new element will be introduced into the telephone situation.

Ever since the expiration of the fundamental Bell telephone patents, there has been an effort made throughout the country to install local exchanges in small towns, a territory rather neglected by the Bell management. These exchanges have often proved to be great successes, but they have invariably encountered subsequent demands from their customers for outside line service which could not be successfully maintained by the small exchanges, especially in the face of existing Bell connections. If now the courts will hold that the Bell Telephone Company is a common carrier and that it must hold its lines open to messages collected over the wires of a local exchange, as well as to those which come directly to the doors of its pay stations, we will soon see a vast extension of telephone exchanges, either by an extension of the present system of local companies or by the Bell company entering this field in direct competition for this class of business.

TRANSFORMERS FOR NET-WORK DISTRIBUTION.

We are gradually beginning to appreciate the importance of secondary wiring net-works operated from large transformers in place of small local transformers, each devoted to a single lighting point. The question of how far this may be economically carried is discussed in Germany in an article in the "Elektricitats Zeitserift" for February 27th, in which the author, Herr Haas, points out that there is a point of minimum installation cost in any such system of distribution. This point may be found by plotting curves representing respectively the cost of secondary leads and the cost of transformers in any particular case. Obviously, the cost of copper will increase as the distance from the lights to the transformer increases, while the cost of transformers will increase as we decrease the amount of copper in the secondary mains. The resultant curve obtained by adding these two quantities will show for any case the minimum point at which the location of various transformers for feeding a given net-work is determined, as is also the size of the transformers to be employed. Herr Haas has endeavored to reduce the problem to an equation giving a general solution. It is obvious to any one who has attempted such a problem that the conditions are always so widely varied that no equation can be found which will satisfy many cases, but at the same time relative costs of transformers and copper may be drawn in curves and the minimum point of the resultant curve found graphically. Graphical methods such as this can readily be applied to the solution of all such problems which require judgment and for extensive application will not only result in the best engineering, but will also give the designer of any plant a more complete faith in his own decisions.

THE EFFICIENCIES OF BOILER FURNACES.

The important series of tests made by the Chicago Edison Company upon the Hawley down draft furnace and the Mackenzie boiler furnace have been published in the "Electrical Engineer" for March 11th, Mr. B. R. T. Collins, engineer of the tests, which show not only that the problem of smoke prevention is practically solved by either one of these devices, but that the efficiency obtained from the use of either one of these two furnaces is satisfactorily high.

Two sets of tests were made with each boiler, one for obtaining the most economical evaporation, the other for

ascertaining the economy at maximum capacity. The very remarkable result appears from these tests that while the Mackenzie furnace is the least efficient at low loads by about 2 per cent, it maintains the efficiency first obtained when severely forced; while on forcing the Hawley furnace, its efficiency falls off about 9 per cent, though before judging immediately upon this result we should notice that while the Hawley furnace at maximum capacity develops more than the rated horse-power of the boiler, the Mackenzie furnace does not succeed in obtaining the full rating of the boiler to which it was attached, and this may possibly explain the high efficiency obtained when forced. However, the Mackenzie furnace does not fall off in maximum capacity below that of the rating of the boiler enough to account for the entire difference in efficiency. The efficiency obtained with these different furnaces are as we have said commendably high, so that one need only determine which furnace to use by comparison of the cost of installation and maintenance in the two systems.

The Hawley furnace requires a water tube grate since the principal amount of fuel rests upon the grate bars, through which the draft passes in a downward direction, and in consequence one would expect the furnace to be subject to a large repair account, while on the other hand the Mackenzie furnace, admitting air for combustion through fire brick pillars in the combustion chambers, would naturally require a large installation cost and would also be likely to entail a large loss in heat when fires were banked—a loss from which the Hawley furnace would be free. The tests given point clearly enough to the relative economy of the two furnaces under the given conditions as we have stated, but we believe we do well in calling attention to the fact that the tests given do not furnish data for choice between the two furnaces, on account of the omitted items necessary for a complete comparison.

Literature.

THE VOLTAIC CELL: Its Construction and Its Capacity, by Park Benjamin. New York: John Wiley & Sons, 1893. Pp. 562. Price $3.00.

In his preface, Dr. Park Benjamin states: "The object of this book is to assist the student and investigator by placing before him a record of the principal discoveries and results relating to chemical generators of electricity, descriptions of many of the most distinctive and approved types of cells and the latest knowledge as to their efficiency, measurement and modes of use.

While undoubtedly carrying out the object thus stated, of furnishing for students elementary information concerning the many types of voltaic cell, we miss the valuable criticism of various plans that could be only furnished by an independent investigation, rather than by a compiler. Though much more limited in scope, Prof. Carhart's little book, treating of primary batteries, carries with all its statements the authority of an investigator whose work is independent of any hope for patent rewards and in consequence, the cells treated are better known to the reader from his book than they can be known from the compilation of Dr. Benjamin.

Perhaps the most valuable chapter in this book upon the Voltaic Cell is the third, in which is treated the subject of electric measurements from the standpoint of a practical engineer who uses portable direct reading voltmeters and ammeters, rather than apparatus adapted only to the physical laboratory. All of the measurements necessary for an engineer's knowledge of a voltaic cell are here described in a clear manner with the use of apparatus available to every engineer likely to undertake the complete investigation of a primary battery. As a compilation of descriptions of cells and patents upon various types of voltaic cells, Dr. Benjamin's book certainly leaves little to be desired. An authoritative statement of their working could only be obtained by an exceedingly extensive and long series of investigations, certainly longer than would be possible for any one investigator to carry out. A further value of the work lies in the fact that the authorities for the various cell descriptions and tables of data are not only given throughout the text, but the book is supplemented with a complete bibliography of books and papers referred to throughout the text. From the standpoint of an independent investigator, Dr. Benjamin's work leaves much to be desired since the information given is generally that published by those interested in a particular type of cell, though as a book for reference, when a description of a particular cell is desired, this complete description and complete bibliography is very valuable to the engineer.

JAMES CLERK MAXWELL AND MODERN PHYSICS—The Century Science Series, by R. T. Glazebrook. New York: Macmillan & Co., pp. 225. Price, $1.25.

This account of Clerk Maxwell's work rather than of his life from the pen of one of his earliest students at the Cavendish Laboratory loses nothing of its interest from the previous publication of the great biography of Maxwell written in 1882 by Prof. Lewis Campbell and Dr. Garnett. The previous work presented to us the man Maxwell, while this short review brings us more closely in contact with Maxwell the worker, though Prof. Glazebrook himself acknowledges that Maxwell was a man of so strong a personality as to make a complete separation of his work from himself an entire impossibility, but on perusal of this book we are led almost to think that Maxwell's life and work were not so closely connected as Maxwell's work with the entire progress of electrical science since his time. One is in fact bewildered in contemplating the life of this great man and ralizing how completely most modern discoveries are involved in the impetus which he gave to experimental physics at Cambridge University and particularly in the advances he was able to make in the theory of electricity and magnetism. Born at so late a date that had he lived until the present time he might not yet be considerd an old man the enormous mass of business and knowledge involved in the term electrical engineering may be said to have found its origin in his investigations and yet, as Prof. Glazebrook has shown us in this life, his career was not solely important on account of his great electrical investigations but also on account of his studies in optics and molecular physics. Reading this review we are more than ever struck with the comparatively great opportunities offered to the present student who has laboratories at his disposal and instructors to aid him far more competent than any Maxwell found at the beginning of his student career, though again we are brought by Prof,

Glazebrook to acknowledge our indebtedness to Maxwell for these opportunities of learning. Maxwell impressed the importance of experimental knowledge upon the Cambridge Examiners; through Maxwell's efforts the Cavendish Laboratory was established, and after it was established Maxwell was the only competent director able to inaugurate experimental physics at the great university. It is perhaps an old story to the present grown generation of physicists that we owe this much to Maxwell, but the importance of this work might be lost sight of in the coming generation unless the rising students should have his position in science clearly defined to them, and for this we are indebted to Prof. Glazebrook, who has written of Clerk Maxwell's work in a manner that is at the same time complete and interesting. It is to be hoped that the book will find its way into the hands of many students of experimental physics and that it will cause them to place Maxwell in his true position as the founder of the mathematical theory of experimental physics.

WESTINGHOUSE ELECTRIC STREET CAR EQUIPMENTS.—By F. L. Hutchinson and Leo Phillips, East Pittsburg, Pa., 1896. Published by the authors. Pp. 91. Price $1.00.

Within the past few years engineers connected with the various manufacturing companies have published descriptions of the machinery with which they are familiar that are exceedingly valuable to the electric public, aside from their value as an advertisement to the manufacturer concerned. This little book, describing the Westinghouse street car equipment, reperesents the best offered in this class of literature, since it puts into the hands of practical men a description of the various pieces of apparatus used in street car equipments by the Westinghouse Company, and furnishes a clear explanation of the duties of the various pieces of apparatus, and explains the care which should be given them without at any time entering upon an argument in favor of the apparatus described, or detracting from that of other manufacturers. Indeed, quite properly, the book might be called a "Manual of Management," and it will prove of value to street car companies using this apparatus, should they place it in the hands of their employes.

In several chapters the motors and car controllers are described, and following these chapters the operation of the car equipment is explained. The correct method of inspection is laid out and instructions are given for localising and remedying faults, followed by instructions for repairing and rewinding fields and armatures. In reading this list of contents, it is plain why we have called this book a manual of management, since no hint is given of proper carwiring, nor is the internal method or operation of controllers and other parts of apparatus explained. Perhaps the points not explained are those which the manufacturers desire to keep under their own control, though how this will be generally possible is difficult to see, for the inquisitive engineer of the present day is fully capable of tracing out the connections of any controller or car-wiring system. Since this is so, it would seem rational for the manufacturing companies to give such clear instructions concerning these points to those using their apparatus, that all may have equal benefit from their explanations. The matter throughout the book is carefully divided into paragraphs separately titled, but we regret to notice the absence of an index which would facilitate ready reference to the information which the book contains. It is to be hoped that other manufacturers will follow the lead here given with an equally clear and explicit set of directions for managing the various pieces of electrical apparatus which they sell.

JOHNSTON'S ELECTRICAL AND STREET RAILWAY DIRECTORY FOR 1896.—Containg lists of electric light central stations, isolated plants, mining plants, street railways, telegraph, telephone and district messenger companies, and manufacturers of and dealers in electrical street railway apparatus, machinery and supplies. 832 pages; cloth. Price $5.00. New York: The W. J. Johnston Company.

In the production of this work, the only one of its kind in America, the object of the compilers is to furnish reliable information regarding electrical, street railway and kindred interests, so arranged and classified as to be of the most practical value and easily accessible. Apart from the convenient classification and arangements of its contents, the Directory gives, among other things, the names of managing officers, superintendents, electrical engineers, purchasing agents, etc., of the different electric light, street railway and other companies; the capital paid in, system in use, etc.; number of lights operated by electric light companies, and whether they furnish electric power; prices paid for city lights by 353 cities and towns; length of each street railway, number of cars operated and equipment in use. According to the figures given in the Directory, there are in the United States and Territories, Canada, Cuba and Mexico, 2711 electric light central stations, with an aggregate paid-up capital of $320,049,518, and 1140 street railways with a total paid-up capital of $890,828,120. 828 of these street railways, with a mileage of 14,850, are operated by electricity, and 312, with a mileage of 2300, by horse, steam or cable power. The Directory also publishes a list of 7150 manufacturers, dealers, electrical engineers, etc., engaged in or catering to the electrical business, and arranged in three different ways: Geographically by States, cities and towns; classified according to lines of business, and alphabetically as a finding list. The scope of the Directory is not confined to the United States, but includes Canada, Mexico, Cuba, Central and South America.

Telephony

CHEAP TELEPHONES IN SAN FRANCISCO.

The Pacific Telephone and Telegraph Company of San Francisco has issued the following to the public: The management of the Pacific Telephone and Telegraph Company, believing that outside of the 1659 residence subscribers connected with the San Francisco exchange, there are two or three thousand or more, householders who really need telephones and do not know it, never having used one regularly, has decided, for advertising and educational purposes, to issue 1000 kitchen telephone sets at the rate of 50 cents per month for the installation of the kitchen telephone and unlimited switching from house to office, or from house to physician, or from house to any other one subscriber in the San Francisco exchange.

Other switches from this telephone may be made to any other one of the 6715 subscribers (connected April 1st, 1896) by the payment of a nickel at the time of making the switch; or the subscriber can contract for 50 cents a month additional, for unlimited switching with any other one subscriber; or by the payment of $1.75 per month he can have unlimited switching from this telephone to all of the subscribers connected with the San Francisco exchange.

This telephone is placed in the kitchen only, where it can

be readily used to the butcher, grocer, coal dealer or to the physician, druggist, etc. These telephones are for outward service only, and on account of the saving made by the company, in the fact that no arrangements are made at these telephones for being called up, and the saving at the central office for the same reason; and as for this purpose, a number of stations can be placed upon one pair of wires; and as stated above, for the general benefit such a service will be to the system as a whole, and as an advertisement, and as an educator for the present non-subscribers, the telephone and all the service mentioned is given at the rates quoted above.

The terms for regular residence service, which includes metallic circuit, long distance transmitter, express service and unlimited use, are $5 per month, or $2.50 per month and five cents for each outgoing switch (inward service free).

This is the service we know you will want a little later on, after you find, as you surely will, that the telephone is as necessary in your household as gas or water.

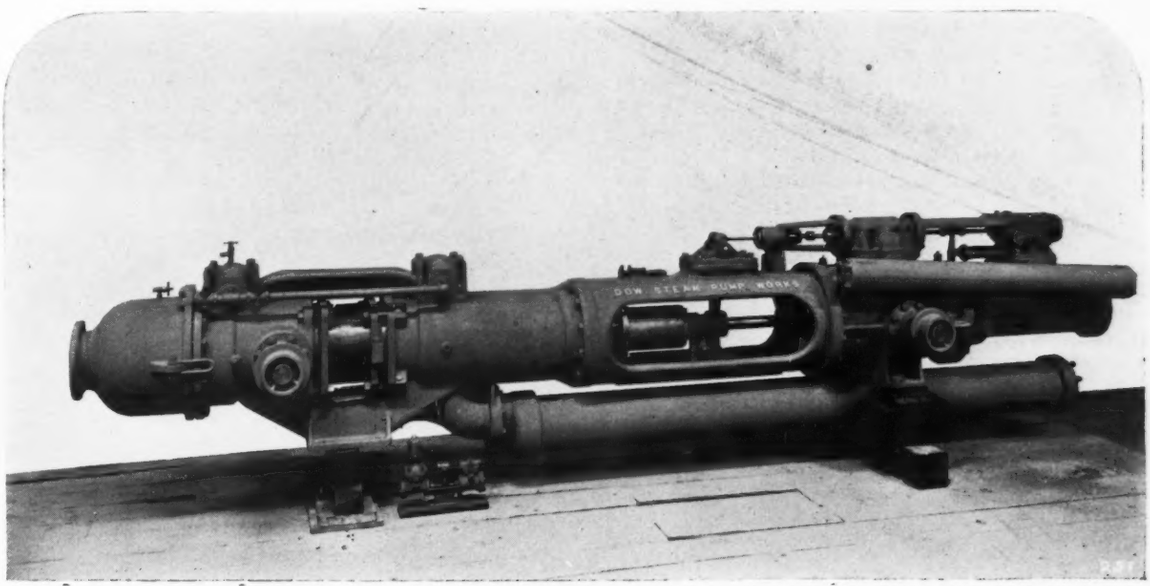

FIGURE 1.—THE DOW COMPOUND DIFFERENTIAL PLUNGER PUMP, OPERATED BY COMPRESSED AIR AT THE NORTH STAR MINE

Pneumatics

COMPRESSED AIR AT THE NORTH STAR MINE.

Since the completion of the Rix air compressors described in the November number of the Journal, the compressed air taken therefrom has been applied to various uses in and about the North Star Mine, Grass Valley, Cal., the most interesting of which are the pumping out of the old shaft on Massachusetts Hill, and the operation of the compound pneumatic hoist. Sixty miner's inches of water or something over a million gallons a day is the amount pumped and even this quantity taken from the old workings does not seem to decrease the supply rapidly, for there are miles of drifts to uncover. The inflow appears at present to be about 600,000 gallons a day, representing a gain on the water of 400,000 gallons daily.

After passing through the reheaters heretofore described, the air is applied at a pressure of 90 lbs. to the 12-inch high pressure air cylinder of the compound differential plunger pump, built by the Dow steam pump works of San Francisco. In passing through the reheater, the temperature of the compressed air is raised to 350 deg. F., and its volume is increased from 40 to 50 per cent., and after being released from the high pressure cylinder the cool air is again reheated to a similar extent and piped to the low pressure cylinder which has a diameter of 14 inches. These cylinders are in tandem and their piston has a stroke of 30 inches. The pump, which is illustrated herewith, has a capacity of lifting 700 gallons per minute to a height of 350 feet and is of the following further dimensions: Diameter of lower and upper plungers, 14 inches and 10 inches respectively; suction, 10 inches; delivery, 8 inches; air pipe, $2\frac{1}{2}$ inches.

The two trunions shown in this cut, one being bolted on the low pressure air cylinder and the other to the water end, are used in connection with a hoisting apparatus for raising and lowering the pump. The pump is built from Dow's latest design, and by an improvement in the construction of the water end, all shock or concussion is done away with, and the pump runs noiseless and without jar. The pump weighs, without water, 15,000 pounds, is twenty-two feet long and is suspended between guides in the pump shaft by a steel wire cable. A special triple geared hoisting engine raises or lowers it in the shaft easily, so that when blasting, or when repair, or repacking is necessary, it may be brought to the surface in a few minutes.

The hoist referred to is a double drum direct connected outfit, operated from two Corliss steam engine cylinders, one of which receives the air at 90 lbs. pressure from the reheater as above. In this first cylinder the air is cut off at about one-half stroke and is expanded to about 25 lbs., whence it is again reheated and applied to the second cylinder. The amount of fuel used in the reheater is about 1-5 the amount required to produce the same harse-power by steam.

The Trade.

In Responding to Advertisements in this Publication, please mention "The Journal of Electricity."

IRON-CLAD ARC ARMATURES.

Realizing that the iron-clad armature has almost completely driven the surface wound machine from the market in constant potential work, the Western Electric Company has designed and put in service a complete line of arc machines having iron-clad armatures and other new features.

The general form of construction of these machines is shown in Fig. 1. The frames are of the bipolar, horseshoe type, with the magnets horizontal. The magnet cores are of wrought iron and the pole pieces and yoke are of cast iron. The bearings are of the self-oiling, self-aligning type, and are provided with visual oil guage and drain. The pulley end bearing is bolted directly to the yoke of the dynamo and the commutator end bearing rests on a brass bracket projecting from the lower pole piece. The bearing bracket is bored out at the same time the pole pieces are bored, so that the removal of the armature is a very simple matter. The bolt can be taken out and the bearing turned around the shaft until the foot is clear of its seat and the armature will then rest in the pole pieces and the bearing can be slid off with a very slight exertion. The simple fact that the armature may be so easily and quickly removed for examination or repairs is a point that is fully appreciated by all central station managers. The bearing may be removed in about five minutes, the pulley in three and the commutator in ten.

The most vital part, in all dynamos of high potential, is the armature. If the armature is not thoroughly insulated and designed for comparatively cool running the machine is destined to a short life. The care taken in procuring first-class insulation of the armature is shown in Figs. 2 and 3, which can readily be understood by reference to the following description:

The armature is built up of very thin sheet-iron rings mounted on a brass spider. The sheet-iron rings have teeth similar to those in the standard incandescent iron-clad armature, the coils are wound in the slots between the teeth and are firmly held in place by wooden wedges, which are driven in over the top of the winding. The armatures are divided into a very large number of coils of comparatively few turns of wire. In this way the voltage in the individual coils is reduced to such a small amount that there is very little strain on the insulation between coils and the voltage between segments of the commutator is so low that it is difficult to flash the machines under ordinary running conditions, and if flashing does occur, the effect on the commutator is scarcely noticeable. By dividing the winding into a large number of small ventilated coils the accumulation of heat in the center of the coils is avoided, thereby preventing the slow roasting of the insulation which occurs in some machines.

The coils are insulated from the core in the slots by a trough which is built up of alternate layers of press board, mica and oiled paper, the sheets of mica being well lapped to avoid any chance of puncturing at the joints. The coils on the inside of the armature are wound in insulating troughs somewhat similar to the troughs in the slots, with the exception that they are narrower and deeper. The ends of the coils are insulated from the core; first by wooden rings which are placed at the ends of the armature and form rounded corners to wind over as well as affording additional insulation; second, by built up "U" shaped troughs which overlap and extend in and around the inside and outside troughs, so that the result is that each coil is wound in a seperate trough built up of four overlapping troughs which effectually insulate it from the armature in Fig. 3.

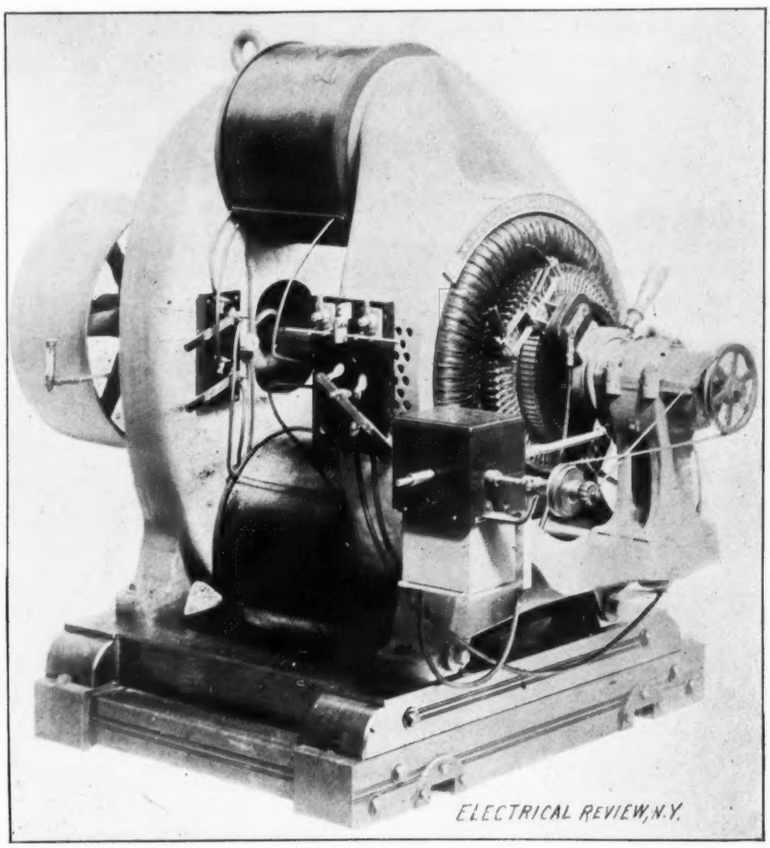

FIG. 1—WESTERN ELECTRIC IRON CLAD ARC LIGHTING DYNAMO

The advantage of this form of construction is at once evident in case repairs become necessary, as any coil can be rewound without affecting the other in any way, and as there are no bands all that has to be done is to slip the armature far enough out of the pole pieces to work on it, and then take off the commutator, rewind the coil and put the armature and commutator in place again. In case one or even four or five coils in an armature become injured it is not necessary to rewind them at once, for if a coil is not short-circuited internally the terminals of the coil can be simply disconnected from the clamp on the commutator and a small jumper put across the same segments to which the coil was previously connected, and the machine can be run with no serious increase of sparking.

If any of the injured coils are short-circuited internally of course the short circuit must be gotten out, or the whole coil may be cut out with a cold chisel. If this is done, it is necessary to take out the opposite coil also in order to keep the armature in running balance. A wooden wedge in-

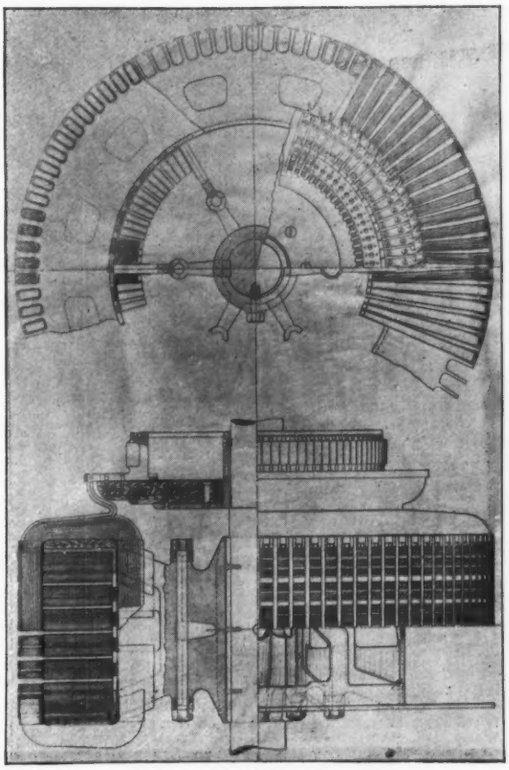

FIG. 2—DETAIL DRAWING

serted in the place of the inner portion of the coil will serve to hold the other coils in place. The success of the system of ventilation adopted is shown by a test in which two armatures were built just alike except that one was wound in the usual way, and in the other the coils were ventilated as shown in the cuts and described below. The former heated 80 F above the air after a 12 hours' run, while the latter only heated 60 F after a 24 hours' run.

The armature discs are supported by extensions on the spider. These points of support which are about two inches wide are directly over the spider arms as shown in Fig. 2. Between the spider arms, in the open spaces, are laid small wooden blocks about one quarter of an inch thick which separate the armature coils from the discs and between every three or four coils on the inside of the armature are ventilating spaces. These ventilating spaces, which are shown very plainly in Fig. 2, open into ventilating chambers in the brass ring which carries the armature discs and this space communicates directly with the spaces between the iron discs which are, of course, open at the outside where the iron teeth come between the coils. By this means there is a free circulation of cool air in through the coils, coming in at the bottom and flowing up through the ventilating spaces between the armature discs and out between the armature teeth. In addition to this the brass spider arms are partially cut away where they pass through the winding at the bottom so that there is an additional opening for the admission of fresh air into the spaces between the armature rings. The iron armature rings are held apart in bunches of about sixty, by radical strips of asbestos which, from

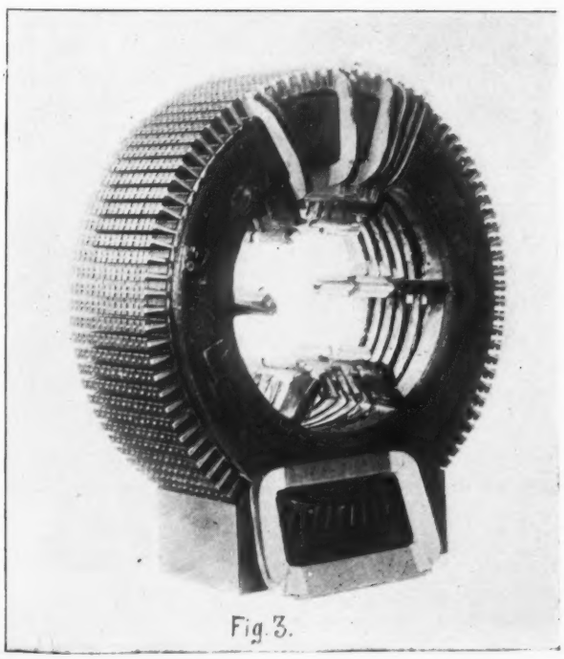

FIGURE 3.—ARMATURE CORE, READY FOR WINDING

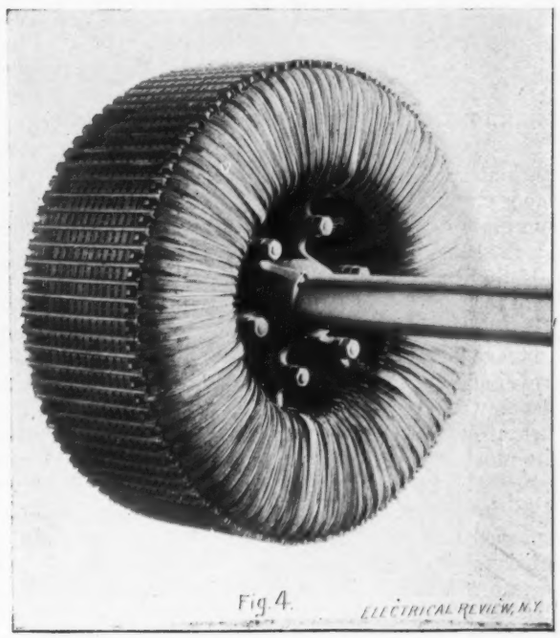

FIGURE 4—ARMATURE COMPLETE, PULLEY END

their action as a centrifugal blower, tend to keep the cool air flowing through the armature.

The special feature of this system of ventilation and insulation is that the entire ventilating space in the armature may be filled up with carbon or copper dust, leaving the insulation of the machine as strong to resist the breaking down strain, due to the voltage, as it was before, for the reason that each coil is insulated independently of the rest in a trough which completely protects it.

The field coils are wound on paper spools $\frac{1}{8}$ to 3-16 of an inch thick, which are built up and flanged over outside of the $\frac{1}{2}$-inch wood veneering heads. The spools are held away from the iron core and the yoke, and pole pieces by wooden wedges so that there is a large ventilating space all around the inside and at the end of the spools. The construction of the spools is such that should this ventilating space become filled with dirt the coils are still effectually insulated.

On the yoke of the machine shown in Fig. 1 is mounted a pair of reducing switches which cut out part of the field winding. The lower switch is for the purpose of adjusting

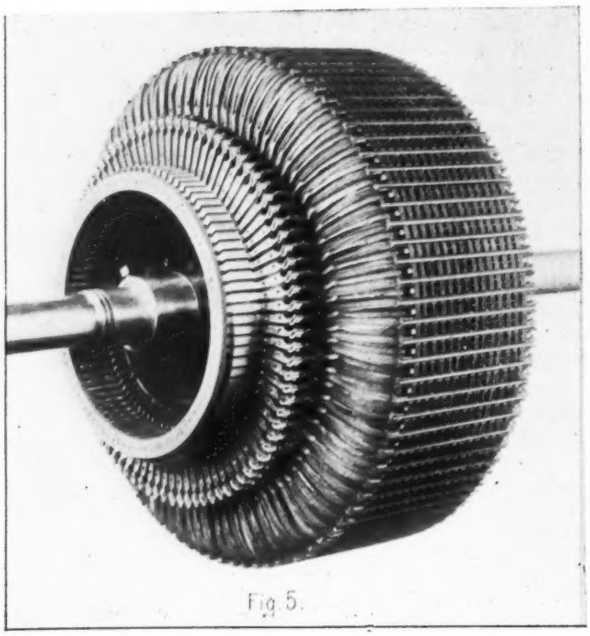

FIGURE 5—ARMATURE COMPLETE, COMMUTATOR END

the spark at the brushes to the conditions under which the dynamo is running. When this switch is open the machine will run along without flashing under normal conditions, though the spark is in this way reduced practically to nothing. If there are sudden and great changes of load, it is desirable to have the machine run with a slightly longer spark so that it will not flash before the regulator has a chance to compensate for the change in the load; this can be accomplished by simply closing the switch.

The other reducing switch is for the purpose of reducing the current output of the dynamo so that if it is desired to run the machine part of the time at a lower current than 9.6 ampers this switch can be closed and the regulator adjusted to the lower current. In this way considerable fuel can be saved when it is not necessary to run the lights at full brilliancy.

The commutator, which is shown in detail in Fig. 2 and complete in Fig. 5, is built up in a very substantial disc of hardwood veneering, which is mounted on a brass flange. This wooden disc is then faced with mica and each segment is screwed to it independently of the others. The segments are tapered slightly towards the inside, allowing slate wedges to be driven between them, thereby protecting the mica facing from the action of any burning that might be caused by the flashing of the dynamos. The outside ends of the segments are held rigidly by a compound ring of mica and veneering, and each segment is held in position on this ring by a machine screw and two dowel pins. The segments are insulated from each other by air spaces, allowing both sides of each segment to be perfectly inspected and cleaned at any time when the machine is not running.

With an air insulated commutator the burning effect of a flashing and short circuits is confined almost entirely to the brushes so that it is not necessary to turn down the commutator after bad flashing, as the case with solid-built commutators. The carbon brushes feed down and compensate for the burning as soon as it is over. All parts of the commutator, which are connected with the circuit of the machine, are on the face of the wooden disc so that there are no parts behind the commutator which have to be cleaned to keep the insulation from running down. Also all screws used in its construction are accessible from the front. The segments are increased in size at the working part so as to provide for a long life, and also to hold the flashing as much as possible in the working part of the segments. This form of construction has the additional advantage that it is not dependent on slate or rubber or any other brittle material for its mechanical support, and yet the mechanically substantial insulation is thoroughly protected by the slate wedges from the burning action of flashing.

The brushes are arranged to cover the commutator over the entire angle spanned by them, and whatever sparking occurs, is concentrated at the tip of the brush. At the brush tip is provided a small independent brush which is automatically fed down to compensate for the increased wear due to the sparking at this point. This independent brush is so narrow that the brush angle remains practically constant, no matter how fast the brush may be worn away by sparking. The tension of all brushes, there being four to each holder, is adjusted by vulcanite handles, carrying a worm screw, which slip down over ratchets; by turning the rubber handle carrying the worm screw the brush tension can be adjusted accurately, and when it is desired to replace a brush the handle and brush spring can be removed entirely from the brush holder and the carbon taken out and inspected or renewed.

In some of the older forms of carbon brush-holders used on air insulated commutators considerable annoyance was experienced from the noise caused by the chattering of the brushes. This has been almost entirely obviated by the construction adopted. In these brush holders the main brushes cover several segments at once and all the brushes are urged by springs in the direction in which the commutator rotates, so there is no chance for the brushes to vibrate. With these brushes it is not necessary to oil the commutator.

The lamps can be thrown off or on in groups equal to 10 per cent of the capacity of the machine from full load down to short circuit or vice versa, and the regulator will compensate for the changes without flashing the machine. Or the whole load may be thrown on or off instantly and the regulator will compensate for the change in a few seconds.

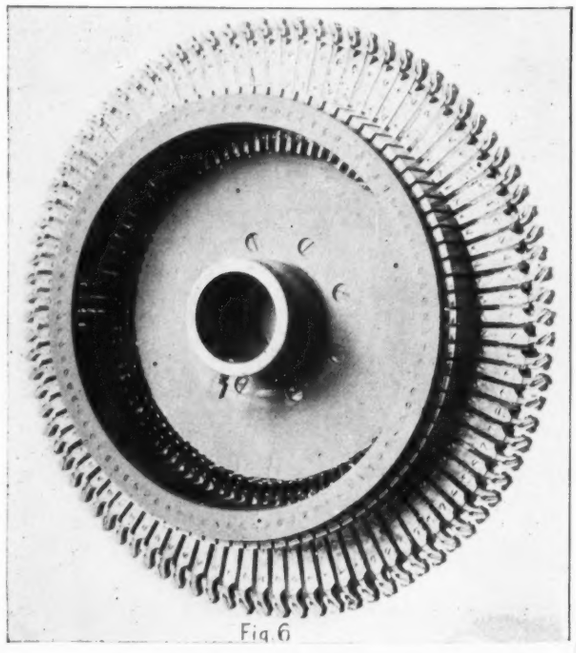

FIGURE 6.—COMMUTATOR COMPLETE, READY FOR MOUNTING

The machines withstand without injury the ordinary accidents of operation, such as open circuit and short circuit, and either side of the circuit may be grounded to the frame and the circuit opened without injuring the insulation. The machines are all designed to run fourteen hours on any load from dead short circuit to full-rated capacity without heating in any part more than 80 degrees Fahrenheit above the surrounding air.

The California Electrical Works, of 35 Market St., San Francisco, handle these iron clad arc lighting dynamos, together with all other lighting or power machinery of the Western Electric Company as its Pacific Coast agency.

A PHENOMINALLY SUCCESSFUL FIRM.

The business of the firm of J. W. Brooks & Co. has been turned over to the Brooks-Follis Electric Co., consisting of Messrs. J. H. Follis and J. W. Brooks, and the combination thus effected fittingly illustrates what can be accomplished in the electrical line on the Pacific Coast under the guidance of energy and keen business acumen. Although one of the youngest concerns in San Francisco, it is probably one of the busiest, and the quarters recently leased by it at No. 523 Mission street are fast becoming inadequate to handle the business that is being developed. Having a select line of agencies, and combining therewith the knowledge that business can best be secured through low prices and the liberal use of the advertising pages of a select publication, the firm has sprung into favor to so great an extent that even the largest of the manufacturing companies are beginning to feel the inroads made into their business and are adopting methods by which it is hoped to check the growth of this sterling concern. Among the orders recently filled by the Brooks-Follis Co. is a carload of carbons of the American Carbon Co., shipped to the Los Angeles Electric Co., and 5000 Packard lamps for the Big Creek Power Co. of Santa Cruz.

The Pacific Coast sales agency for the New York and Ohio Co., manufacturers of the well-known Packard lamps and transformers, has been placed with the Brooks-Follis Electric Co. In addition to the usual sizes and efficiencies of incandescent lamps, the Packard "Mogul" lamp has attained popularity. This is a 300-candle power incandescent lamp, which, burning at 2.6 watts per candle power, consumes 780 watts. It is the equivalent of 18 ¾, 16 c. p. lamps, which, burning at the ordinary efficiency of 3.6 watts, consume 1080 watts. There is thus a saving of 300 watt hours in favor of the "Mogul" for an equal amount of lighting service. The Packard transformers are also guaranteed by the manufacturers to be unsurpassed in regulation, efficiency and convenience.

THE PACKARD "MOGUL" LAMP

THE PACKARD TRANSFORMER

THE PORTLAND GENERAL ELECTRIC SUPPLY HOUSE.

The Portland General Electric Co., furnishing current for the operation of all electrical industries in and about Portland, Or., with the exception of the City and Suburban Street Railway Co., has determined to go into the electrical supply business on an extensive scale and is now fitting up three large ware-rooms in the building opposite its office and sub-station on Seventh and Alder street, where it will be prepared to fill all orders of whatever magnitude direct from stock. This stock will consist of everything essential to the installation, operation and maintenance of electric lighting and power work and will include not only dynamos, motors and all accessory equipment, but also supplies of every description for wiring purposes, even to fixture work. Without doubt, the supply department of the Portland General Electric Co. will very shortly become the headquarters for electrical supplies for the States of Oregon, Washington, Idaho and Montana.

FORCING PLANTS BY ELECTRICITY.

Some highly interesting experiments in the development of plants by the electric light have been concluded by the Cornell department of horticulture. By using electric light during the day time, Prof. Bailey produced lilies fully two weeks before the plants grown under natural conditions flowered. The effect on lettuce was very marked. The plants were larger and much more rapid in growth than those raised in the ordinary way. Investigations are to be continued on different plants, and the effect on vegetation of the Roentgen rays will also be determined. Tests will also be made on plants by electrifying the atmosphere in which they are grown. Ozone is specially grateful to some classes of plants, while to others an abundant supply of it does not appear to be essential. The same difference is found in plants subjected to the influence of the electric light. For instance, while lettuce thrives astonishingly under the electric light treatment, electricity is a positive detriment to peas.

AN EXTENSIVE TELEPHONE SYSTEM FOR JAPAN.

The Engineers of the Department of Communications of the Imperial Government of Japan have received instructions to prepare estimates of cost for the surveying, designing and installation of an extensive telephone system that will connect every portion of the island with metallic service. The long distance lines of the proposed system will altogether aggregate 25,000 miles in length and the plan contemplates the establishing of 40 main offices and 180 public stations, which will be capable of handling 25,000 subscribers At present telephone exchanges are in operation in Yokohama, Tokio, Osaka and Kiobe, while in August next an exchange will be in operation in Kioto. The system will embody both land and sub-marine construction and the line construction will probably be begun in the summer of 1897. The cost of the work is estimated at $7,000,000.

DON'T ALL SPEAK AT ONCE.

That it is necessary for a trustworthy and successful electrician to have widely diversified talents before being able to attain his mark in the world, has long been appreciated, but perhaps, if indications do not fail, by none more thoroughly than by the writer of the following letter, which was recently received by the Journal of Electricity.

Sir: What kind of an Ad. will you publish in your paper, which I observed in a news-stand, for, say four bits? I'm endeavoring to get mechanical work, in the electrical line if possible. The Electrical Review in December published a plaint from an Eastern man who could not seem to get the work he wanted, simply because he wanted it, probably, and I wrote a similar one which was also put in; a fine place, too; regular reading matter! January 16th issue, I think. I never received a single reply to it! Perhaps I am too far off. For that reason I tho't it would pay me to pony up 50c for a local paper.

Fate seems to will that I get anything but mechanical work. Am hanging on to an office job at present (can keep books), but it's ruining my eyes. Experience through three years in electrical work; bell hanger's "wire pulling" (the only "pull' I ver had!) Also to manufacture small apparatus and tending gas-engine-dynamo combination.

Have recommends. One from last employing company (now defunct). Understand m'f'ure, care and action of apparatus in general and batteries. Some chemical knowledge. Drug store experience one year; sign painter (show cards), and a fair window dresser. Will go town or country.

As an inducement to the locality furnishing me work, I wil be found a very desirable addition to any musical organization fostered by such community, as I will be found capable of filling the first or solo B flat cornet chair in the town's band (they all have 'em, you know), as I have experience through seven years as cornetist from church lofts to brass bands Have made electric work my object, being mechanically inclined. (Of Yankee extraction.) Have had any number of free insertions in the musical journals, but being all Eastern published. Eastern men were handier, I suppose. 19 years old, good habits, etc.

Any one desiring the services of such party, please address "B," Journal of Electricity.

The Lay Press.

POPULAR REFLECTIONS OF THE CONDITIONS AND PROSPECTS OF ELECTRICAL ENGINEERING ON THF PACIFIC COAST.

The difficulty of getting cordwood is constantly on the increase, especially as a close watch is now kept upon the cutting of timber on public lands. It is inevitable that cheap electrical power must come before Mariposa can take her legitimate place among the great gold-fields of the world.—Mariposa (Cal.) Gazette.

Electrical power enterprises are just now demanding great attention throughout Utah. Water power for the generation of electricity is abundant, and a wide and profitable field for the application of this cheap power is presented by the mines and mills in the mountains and the manufacruring plants in the valleys. Chained lightning promises to greatly stimulate the development of great manufacturing resources. A region so rich in raw materials, and supplied with the most economical power known to mankind, with a belt extending from the British possessions to the Mexican boundary as its market, has limitless possibilities before it.—Salt Lake City Mining Review.

The use of e'ectric roads (for hauling freight cars to points in country districts away from the steam railroad lines) would be very applicable here in Southern California, where there is so much produce of a valuable character raised within a small area of country. For instance, it would be a good thing for the electric road which runs from Los Angeles to Santa Monica to try the experiment of putting on a few freight cars during the winter, when winter vegetables are being shipped to San Francisco and the East. The general introduction of such roads would make the farmers in the neighborhood of a large city to a great extent independent of the railroad companies.—Los Angeles (Cal.) Times.

The Z. A. Willard syndicate of Boston is, it is learned, through Mr. J. H. Linn of Murphys, Cal., already engaged in making the preliminary surveys for the installation of an electric power and light plant to be located on the middle fork of the Stanislaus river. It is intended to make it one of the largest and most complete power stations in the State and will have a capacity of fifteen thousand horse-power. Application will soon be made to the Board of Supervisors of both Calaveras and Tuolumne county for the necessary franchise, as the company expects to substitute electricity for steam power in nearly all the mines and industrial enterprises in both counties. The rapid growth of the mining industry in this section makes it necessary that some such agency be employed for power instead of steam in the development of the mining interests. There are untold numbers of low-grade undeveloped properties in both counties, that with cheap power can be made to pay a nice profit, while without it they must continue to lie dormant. The progress of this region has no more unrelenting and ever present obstacle in its path than the cost of fuel and in some instances the scarcity of water. In Mariposa county they have felt the same drawback so keenly that the aid of a San Francisco syndicate of capitalists has been enlisted by Mr. H. H. Clark of the Horseshoe Bend, to erect a power plant at the famous bend of the Merced river, four miles from the town of Coulterville, and before a pick was struck contracts had been made for furnishing nearly all the power they can develop. The same condition will prevail here

before long; not only in the field of power supply but electric light as well, will there be found a profitable business. The booming mining camps of Jamestown, Quartz Mountain and Stent already justify the extension of a system of lighting in their midst. The three places are situated within a radius of three miles and since the sale of the Whiskey Hill group to a Boston Company, much is expected from the former town in the way of rapid growth. The necessity for the introduction of additional lighting and power facilities is becoming so apparent that no corporation would experience much trouble in floating enough of their stock to insure the success of the undertaking. Mr. J. H. Linn, who represents the syndicate in this county, is quietly pursuing a thorough investigation into the feasibilty of the project in so far as it relates to the section lying south of the Stanislaus and has met with so much encouragement that his report will be of a roseate hue.—Sonora (Cal.) Democrat.

Reports of the Month.

INCORPORATION

Willits, Cal.—The Mendocino Electric Company is about to be incorporated by W. A. McCornack, Albert Brown, Charles Packard, L. A. Morgan, J. D. Johnson, Joshua Grindle and William Heeser, for the purpose of furnishing electric light and power for Mendocino and vicinity.

Sonora, Cal.—The Tuolumne County Electric Power and Light Company. Authorized capital, $1,000,000, of which $666,641 has been subscribed. Directors: W. D. Baumister and James McCormick of Tuolumne county; William Grant, A. F. Fechteler and David Hearfield of Marin county, and John J. Crook and P. R. Jarboe of San Francisco.

San Diego, Cal.—The Citizens Traction Company, capital stock $100,000 of which $800,000 has been actually subscribed by the following directors: George B. Kerper $57,400, C. W. Foote $19,900, J. E. O'Brien and G. C. Arnold $100 each, and J. B. Mannix $500. J. B. Mannix as trustee holds twenty shares valued at $2,000. Object, to rebuild and equip the San Diego cable road with electricity.

Sacramento, Cal.—The Sacramento Electric, Gas and Railway Company. Capital stock, $2,500,000. The incorporators and first board of directors are: L. P. Drexler and Albert Gallatin, Jr., of San Francisco; Charles R. Lloyd of Oakland and J. W. Hall and L. T. Hatfield of Sacramento, and its object is to purchase all the property, rights, privileges and franchises of the Sacramento Electric Power and Light Company, also of the Folsom Water Power Company, and provision is made for engaging in all the various kinds of business heretofore engaged in by either of those companies, with authority to produce gas of different kinds, and all kinds of illuminants. It is understood that acetyline gas is the kind of gas in contemplation.

TRANSMISSION.

Mariposa, Cal.—There is nothing new reported about the Bend Power Company. There is some talk about another electrical power plant being started higher up on the Merced river some distance above the Benton Mills.

Stockton, Cal.—Charles Swain, of the famous Confidence mine, near Sonora, from which over $2,000,000 was taken prior to 1880, states that the company has under contemplation the installation of an electric plant for power purposes on the Tuolumne river four miles distant.

Salt Lake City, Utah.—The Garden City Electric Co. has submitted a proposition to the City Council offering to light the city at $8.50 per arc lamp per month, if a franchise be granted it, and the company proposes to transmit power from Provo River, forty-five miles distant.

Perris, Cal.—Prof. C. G. Baldwin of Ponoma has acquired a water power in the San Bernardino mountains with which it is proposed to install an electric transmission plant for pumping water for irrigation purposes in Perris valley and for furnishing power for mines and manufactures.

Dixie, Idaho.—The Golden King Mining Co., recently incorporated with a capital of $1,000,000, has employed L. C. Trent of Salt Lake City to draft plans and specifications for a 100 h. p. electric power transmission plant, to be operated from the South Boyse River, five miles from the mine.

Riverside, Cal.—A shipment of 80,000 pounds of copper, 45,000 pounds of which is of No. 4 bare wire has been received from the John A. Roeblings' Sons' Co. for the Riverside transmission. The work of installation is progressing satisfactorily and the plant will be in operation as promised.

City of Mexico, Mex.—The Nuevo Leon Legislature has authorized J. A. Robertson to erect a dam in the Poterero de Santa Catarina Canyon, on which must be spent $500,000 during the next five years, and the company is to have the right to use or sell the water for irrigation of power transmission purposes.

San Bernardino, Cal.—G. W. Fox, representing an Eastern syndicate states that his syndicate have purchased 744 acres in the Muscupiave Rancho, San Bernardino Co. for $100,000 and that the purchase includes 300 inches of water with more to be developed and a portion of which will be used for electric transmission purposes.

Sacramento, Cal.—The Central California Electric Co. has awarded the contract to the Westinghouse Electric and Manufacturing Co. for the installation of its proposed transmission plant from Newcastle to Sacramento. The sub-station will be located on Twelfth street, between E and F, and the operation of the plant by October is promised.

Santa Cruz, Cal.—The Big Creek Electric Power Co. have secured a franchise in this city, the consideration being $1000 and the free use of 10 arc lamps. The extension of the circuits of the Big Creek Co. to Alma, Los Gatos, Saratoga and San Jose, a distance of 24 miles, is under consideration. The pole line has been completed and the plant will be in operation early in June.

Riverside, Cal.—The city has paid to the Redlands Electric Light and Power Company $13,000 as the first installment on the new electric plant, and a large force of men are at work setting up poles and doing other work preparatory to lighting the city. The material is all on hand, and the work of placing it will be crowded ahead as rapidly as possible. It is expected that the plant will be in operation by August 1st.

LITIGATION.

Fairhaven, Wash.—The legal fight for possession of the Fairhaven and New Whatcom Street Railway is becoming more intense. The Superior Court appointed as receiver E. J. Hill, at the request of resident creditors of the company, and the American Trust Company, representing the Eastern bondholders, are dissatisfied, and now sue in the Federal Court for the appointment of Norman Tucker, their choice for receiver, who will protect the interests of the bondholders in

preference to local creditors. Already 13 answers have been filed to as many suits, and the end is not yet. The bonded indebtedness of the road upon which these suits are now founded amounts to $300,000. It is not believed that the road will bring above $100,000, and should the effort to foreclose result favorably to the bondholders, they would take this amount to the detriment of local creditors. The Fairhaven City Council at a recent meeting repealed the ordinance under which this company was given a franchise through the city, which action, it is alleged, was taken through sympathy for local creditors, and to impede the efforts of the electric company in their foreclosure proceedings.

San Francisco, Cal.—Judge Belcher of the Superior Court has handed down an opinion on the rights of stockholders to demand and examine corporation books. The opinion was in the case of the People vs. James Fisher, Secretary of the Mutual Electric Light Company. The defendant had been tried in the police court on a complaint made by George E. Whitaker, a stockholder who had been denied access to the company's books, and was fined $50.00. Judge Belcher, affirming the judgment of the lower court, says the right of inspection of a corporation's books by a stockholder "seems to be absolute in proper cases, even in the absence of legislation, and damages may be recovered for refusal." And the stockholder may inspect through his duly authorized agent or attorney. The right to inspect carried with it the right to make extracts and memoranda. Further, Judge Belcher says: "In California the stockholders have the same right as the members of an ordinary partnership to examine the books of their company at any time." Commenting upon the California statutes, the Judge says: "It seems to me that the statutes of this State giving stockholders the right to inspect the books of their companies, and providing a penalty for refusal, are highly beneficial in nature and should be liberally construed to effect the ends in view." The Judge says that if the books are in use at the time called for and the stockholder is asked to wait a reasonable, specified time, such a request to wait cannot be construed as a refusal.

San Francisco, Cal.—Superior Judge Seawell has refused to restrain Superintendent of Streets Ashworth by injunction from removing the lamp-posts erected on Market street by the Mutual Electric Light Company. The company was granted permission to lay conduits on Market street, between Kearny and Grant avenue. The permission carried with it the right to connect the conduits with business blocks on either side of the street, but the company went further and put up lamp-posts. Superintendent Ashworth ordered the removal of the posts, and the company obtained a temporary restraining order. In dissolving the injunction Judge Seawell said: "Anything which unlawfully obstructs the free passage or use in the customary manner of any public street or highway is a nuisance. The sidewalks of a public street are parts of the street. Any unlawful obstruction of a sidewalk is therefore a nuisance. The Board of Supervisors may authorize the erection of lamp-posts in order to light the city, and when so erected they cease to be a nuisance. The burden of showing that a particular obstruction has been placed in a street by lawful authority is on the plaintiff. The constitution provides that lighting corporations may under the supervision of the municipality lay pipes and conduits in the public streets and thoroughfares and make connections with them so far as may be necessary for supplying the city with light. Judge Seawell was of the opinion that the use granted did not extend to the erection of lamp-posts on the streets. He found that no such right was expressly granted, and he believed it the intention of the law to give to the municipality the exclusive right to regulate the manner of lighting public streets. The restraining order was therefore vacated."

TRANSPORTATION.

Phoenix, Ariz.—The Fowler Railroad franchise has been extended until April 9th, 1897.

Pasadena, Cal.—The line of the Pasadena and Pacific Railway Co. is now in operation to the Southern Pacific depot.

Long Beach, Cal.—An eletric road to extend in almost a direct line southwest from Los Angeles to this city is being projected.

Berkeley, Cal.—Experiments are to be made with a gasoline motor on the horse car line running between East and West Berkeley.

Redlands, Cal.—F. A. Miller, Secretary of the Riverside and Arlington Railway Company, has secured permission to equip the line with electricity.

Santa Rosa, Cal.—It is probable that one or more of B. L. Ryder's compressed air motor cars will be placed on the line of the Central Street Railway Co.

San Luis Obispo, Cal.—J. L. Howard and E. Goodall have been granted a 29-year franchise for a single track railway on Marsh street from Essex to Johnson streets.

Stockton, Cal.—The Stockton Gas Light and Heat Co., operating the Stockton Electric Railway, has installed a new 150 h. p. 500-volt Westinghouse generator for operating its power circuits.

Salt Lake City, Utah.—The Board of Supervisors have accepted C. R. McKay's proposition for the installation of a Sprague-Pratt high duty elevator in the joint city and county building.

Portland, Or.—The use of the cable on the Portland Heights Incline is still continued, but it is being operated by a 125 h. p. 500-volt T. H. bi-polar motor, driven from the trolley circuit of the Portland Cable Railway Co.

Oakland, Cal.—The California Railway is now being operated as an electric line and standard trains are being hauled over it by electric locomotives of the Baltimore & Ohio types, carrying two G. E. 1200 equipments.

Redlands, Cal.—It is rumored that A. K. Smiley of Redlands will build an electric mountain railroad to Fradelba Park, the summer resort planned for him on the summit of the San Bernardino mountains. The enterprise will cost $175,000.

Santa Barbara, Cal.—Ten tons of trolley wire have been ordered by the Santa Barbara Consolidated Electric Railway Co., from the Washburn & Moen Manufacturing Co. Active building operations on the new line will begin not later than June 1st.

Stockton, Cal.—The purchase of the Stockton Street Railway system by the Stockton Gas, Light and Heat Company, is receiving the consideration of F. A. Hihn of Santa Cruz and Oliver Eldridge and Wm. J. Dutton of San Francisco, of the Gas Company's directory.

Santa Monica, Cal.—The line of the Santa Monica and Soldiers' Home Railway Company running to South Santa Monica is to be equipped with electricty and it is expected that power for the operation of the new line will be furnished by the Pasadena and Pacific Railway Company.

San Andreas, Cal.—Prince Poniatowski of the California Exploration Company has gone to London to secure capital for the development of the company's projects, among which are the building of a broad-guage electric road from San Andreas to Valley Springs, a distance of ten miles, where connection will be made with Lodi on the Sacramento and Stockton branch of the S. P. R. R.

San Diego, Cal.—The Citizens' Traction Co., organized by the owners of the San Diego Cable Road for converting the cable

line into an electric system, is rushin g the work of reconstruction and expects to have the new line in operation by July 1st. General electric equipment is to be used throughout, and the plant will consist of 2 100 kw. multi-polar generators and six car equipments.

Kingman, Ariz.—A company is soon to be organized for building an electric railway in Mojave County to run from Kingman to the various mining camps hereabout. The first line will be built to White Hills and will carry freight and passengers. Among the mining camps to be reached by the proposed road are Cerbat, Mineral Park, Chloride, White Hills, Weaver, Minnesota and El Dorado Canyon.

Clovis, Cal.—W. R. Birmingham of Pollasky, who is manager for the Michigan Lumber Company, is reported as saying that the Eastern Lumber Company, which has a large belt of magnificent timber on the North Fork of the San Joaquin, in Madera county, will not build a flume to Pollasky as formerly intended, but will construct an electric railroad from their timber to Fresno. The company expects to get its motive power from the San Joaquin Electric Company.

Nevada City, Cal.—It is stated that Hon. John F. Kidder, who owns the franchise for an electric railroad between this place and Grass Valley, has about completed negotiations whereby the Nevada County Electric Power Company will come into possession of the franchise and build the road. It is understood that a company has been organized with $80,000 capital, and that the bulk of the stock is held by by the management of the Nevada County Electric Power Company, which incorporation is to supply the electricity necessary to operate the cars.

Alameda, Cal.—The extension of the Alameda, Oakland and Piedmont Electric Railway from Alameda to Laundry Farm is being actively pushed. This road will supersede the standard steam line known as the California Railway. The construction will be most substantial, and the new line will be the first to be equipped with the Nantasket trolley wire of Roebling manufacture. The road will be operated by a double end locomotive of the Baltimore and Ohio type. Alexender Flatland has resigned the electricianship of the Alameda line and Leon H. Wolf has been promoted to the vacancy.

Elmhurst, Cal.—The steam eqipment of the Oakland, San Leandro and Haywards Electric Railyaw Co. consists of three Heine boilers of 150 h. p. each, run at 120 lbs., two tandem compound McIntosh & Seymour 150 h. p. engines, each 11½ x 19 x 15-inch stroke, and one tandem compound Ball 500 h. p. engine, 18 x 30 x 18-inch stroke, and Conover & Davidson jet condensers. The cooling pond is 60 feet square, contains 100,000 gallons of water and water leaving the condenser at 130 deg. runs 900 feet and is pumped at 90 deg. Four Thomson-Houston M. P. 90 and one General Electric M. P. 400 generators are used.

San Francisco, Cal.—The Market Street Railway Co. has extended the Ingleside line from the racetrack to the Ingleside House, and is now constructing the roadbed for the electric line on Folsom street. It is announced that the company intends to change the Howard, Post and Montgomery street lines to the electric system at an early day. Another portion of the Omnibus system which it is proposed to reconstruct is the horse-car line on Tenth street, from Howard to Potrero avenue. It is intended to lay a double track electric roadbed on Tenth street and form a connection with the Bryant and Brannan-street system and to connect the San Bruno road line with the Army street road, which was built by the old Beach and Mission Company four years ago, but never operated. The Army street tracks were laid from Folsom to San Bruno road and the roadbed is in readiness for the trolley cars, with the exception of the overhead work. The California Exploration Company has been organized for the development of various transmission railway and mining projects in California. E. H. Brandt has been appointed Chief Engineer, and the principal officers are: President, Charles E. Green, Secretary of the Crocker Estate Company; Vice President, N. P. Cowles; Secretary, C. Torson. Orders have been given for two Siemens-Halske 400 kw. railway generators to be directly coupled to triple expansion vertical engines, built by the Union Iron Works and for use in the Bryant street power house.

Los Angeles, Cal. The Los Angeles Consolidated Electric Co., has moved its offices from the power house to the corner of Sixth street and Wolfskill avenue. The stockholders of the Main street and Agricultural Park Railway, operating the mule line on Main and Jefferson streets and Wesley avenue to Agricultural Park have passed resolutions authorizing the issuance of $350,000 bonds to re-equip the line as an electric road. Certain Eastern capitalists are credited with believing that there is a field for an electric road from this city to Redondo, Long Beach and San Pedro and that having failed in their desire to buy the Redondo Railway they will parallel that system. The Los Angeles and Pasadena line has secured a franchise running from Shorb's station to Alhambra, Santa Anita and Monrovia. W. H. Workman has secured a franchise for an electric road to run from Stephenson avenue and Third street east to Santa Fe avenue, south to Short street, south to Fourth street on the east side of the river, east to Fourth to the corner of Boyle avenue, east on Fourth to Fresno, north on Fresno to First, to the eastern city limits; also a line commencing on Sixth and Hill streets, running east to Ceres avenue, and thence to Third street. Rumors prevail to the effect that the Los Angeles Traction Company will extend its line to Santa Monica. Abbot Kinney and associates have secured a large block of stock in the Mateo street and Santa Fe Avenue Street Car Co., and will probably displace the horse cars with electric service. The Ninth street line of the Los Angeles Railway Co., is now in operation.

ILLUMINATION.

Alameda, Cal.—The city is removing the poles set up by F. N. Delanoy's Electric Light Company.

Redondo, Cal.—H. J. Lindsay proposes to furnish this town with nine 2000-c. p. arc lamps for $100.00 per month.

Phoenix, Arizona.—Messrs. Copeland & McCallum have secured a franchise for an electric light works, water works and cold storage plant, and are already operating the electric plant from their machine shops.

Logan, Utah.—The City Council has granted a 40 year franchise to the Hercules Electric Power Co., in view of which and despite the fact that the city owns electric light and water works, bids for street lighting have been called for.

Mokelumne Hill, Cal.—W. T. Harris, Superintendent of the Roanoke Mining Co., has made satisfactory arrangements for the installation of an electric plant to furnish the Moser and Lamphere mines with power and Mokelumne Hill with lights.

Fort Bragg, Cal.—The City Trustees have accepted the proposition of the Union Lumber Co., to light the town with 40 incandescents for which $200 is to be paid before July 1st for wiring etc., the lamps to be operated at a monthly rental of $24.

Oakdale, Cal.—J. W. Tulloch of the Knights Ferry Electric Lighting Plant states that he is installing a dynamo in the Knights Ferry Fouring Mills to furnish light for this place.

The distance was 12 miles and the pole line construction is finished.

Oakland, Cal.—The street lighting committee of the City Council has recommended that bids for furnishing not more than 470 and not less than 420 electric lights for next year be called for. At present there are 420 electric lights in the city and 89 gas lights.

Anaheim, Cal.—The Board of Trustees of Anaheim has decided to call for municipal bonds in the amount of $18,000 for the purpose of improving the city water and electric light system. L. B. Pemberton of Los Angeles estimates that the electrical improvements will cost $7685.

Saucelito, Cal.—Jacob Strittmatter is erecting a power house, 26 by 60 feet, for the Saucelito Electric Light and Power Co.

Wheatland, Cal.—The Nickerson mine at the junction of Bear river and Wolf creek is being fitted up by an English company with electric lights, drills and power.

Yreka, Cal.—A competing electric light plant is promised and the party canvassing for the new company will extend the system to Montague over the telephone poles, if he receives sufficient encouragement. A plant will probably be put in at Pokegama, which has excellent water power.

Berkeley, Cal.—The Berkeley Electric Lighting Company is about to erect a new $20,000 electric station on its property at the corner of Third street and Channing way, West Berkeley. The station will have a total capacity of 400 horsepower and will be capable of supplying 5000 16-c. p. lamps.

Oakdale, Cal.—The Stanislaus Milling & Power Company has purchased an additional Westinghouse 35 kw. alternator to be placed in the Knight's Ferry plant for lighting this place. The distance of transmission will be 12 miles and it is expected that the plant will be in operation by April 15. Charles T. Telleck is Manager.

Vallejo, Cal.—The fact that Vallejo is without an electric light plant has drawn the attention of capitalists who are looking for a chance to invest, and it is probable that a new company will be organized shortly. The city of Vallejo has gone to the extent of its liabilities in constructing new water works, and could not also build electric light works.

Alameda, Cal.—The report of Chas. E. Naylor, expert made to the municipal ownership league has been rendered bases upon the warrant books for "the 100 months of ownership under favorable conditions." From the report it appears that the total cost of plant to date plus five per cent interest is $171,433.02 and that the net cost to date is $49,112.61. If interest is charged on the bonds issued amounting to $8,139 and not on the net cost, the net cost to date is $41,059.50. The loss and gain tabulation shows net profits amounting to $44,077.03 which is obtained by deducting $76,876.68 for expense and repairs from $120,953.71 the amount credited for lighting service. On the investment to date the estimate is $77,997.29 which with interest charge makes the total of $94,556.34. The inventory salutation of the property is fixed at $50,150.75 and the report shows that the net profit is $2,077.75. The expert declares that the plant can be made self supporting by increasing its capacity to 5,000 incandescent lamps.

The temporary injunction prayed for by J. T. Fleming restraining the City Trustees from making further expenditures towards extending the municipal lighting plant has been dissolved.

MISCELLANEOUS.

Sonora, Cal.—The owners of the Rawhide Mine are arranging to build an electro-plating works at the mine to be of sufficient capacity to do not only the work for the Rawhide and App mines, but all custom work as well. In addition to this improvement a new chlorination plant is to be built immediately, the present one of three tons capacity daily is only about one half large enough. They are now running three eight hour shifts on it in an endeavor to keep up with the output of sulphurets, but find it an impossible task. The electric power is being used to run the mill but not the hoist. As soon as larger motors can be brought here to take the place of those now in position, the whole plant will be run by electricity.

Sacramento, Cal.—On May 15th a superb special train conveyed a large party of influential men on an excursion from San Francisco to this city and Folsom, as guests of the General Electric Company of New York and the Sacramento Electric Light and Power Company, to inspect the plant of the latter concern.

The party consisted of representative business men, capitalists, bankers and well known men of affairs who are interested in utilizing electric power and studying the problems of its long-distance transmission. The guest of the day was General Manuel L. Barillas, ex-President of Guatemala, who is greatly interested in the development of electric power. Colonel N. P. Tisdell, special agent of the Pacific Mail Steamship Company for Central America; Pedro Bruni, manager of General Barillas' estates; Adolph Meyer, president of the Champerico Railway Company of Central America; Florentine Souza, a capitalist and coffee planter of Guatemala; C. A. Coffin, president of the General Electric Company; Serio Mine, Special Commissioner for the Japanese Government to the United States; W. H. Mills, William Angus, Joseph Brandenstein, John A. Britton, Frank L. Brown, S. C. Bigelow, J. B. Crockett, president of the San Francisco Gas Company; W. S. Goodfellow, Bruce Hayden, John L. Howard, C. G. Hooker, E. C. Jones, William Sanders, president of the Oakland, San Leandro and Haywards Railroad; J. A. Lighthipe, engineer for the General Electric Company; Daniel Meyer, H. W. Meek, D. E. Martin, George A. Moore, president of the Pacific Mutual Life Insurance Company; E. B. Pond, ex-Mayor of San Francisco; W. F. Perkins, W. F. Rank, James B. Stetson, president of the San Joaquin and Valley Railroad; F. W. Van Sicklen, Fred P. Fish of New York, attorney for the General Electric Railway Company; R. P. Schwerin, vice president and general manager of the Pacific Mail Steamship Company; Captain John T. Wright, T. L. Barker, Dr. Thomas Addison, Pacific manager of the General Electric Company; L. P. Drexler, Charles R. Lloyd, C. N. Beall, engineer of the Bakersfield Electric Power Company; J. K. Wilson, president of the Sather Banking Company; M. H. De Young of the San Francisco "Chronicle;" C. C. Bemis, J. S. Hutchinson, A. Carrigan, William G. Kerckhoff, I. F. Moulton of the Bank of California; F. L. Lipman, G. F. Richardson, master of transportation Southern Pacific Company; Thomas B. Bishop, John I. Sabin, president of the Bell Telephone Company; Charles A. Hugg of Spreckels Brothers, W. H. Chickering, A. C. Balch, W. F. Pierce, ex-Mayor of Oakland; James Treadwell of the Corral Hollow coal mine property.

From Sacramento there were Frederick Cox, president California State Bank; W. E. Gerber, cashier California State Bank; Joseph Steffens, president, and George B. Katzenstein, secretary, of the Chamber of Commerce; C. H. Hubbard, Mayor of Sacramento; J. A. Woodson, V. S. McClatchy, Jabez Turner, ex-Mayor of Sacramento; J. N. Larkin, E. K. Alsip, A. A. Von Voorhies, G. M. Mott, E. C. Rutherford.

The special hosts managing were Albert Gallatin, president Sacramento Electric Light and Power Company; H. P. and Charles E. Livermore of the same company; Manager Hall and Superintendent Shock of the same company; Dr. Thomas Addison, of the General Electric Company; and Joshua Barker, secretary of the Sacramento company.

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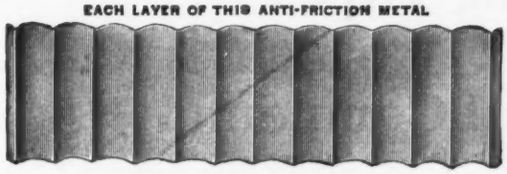

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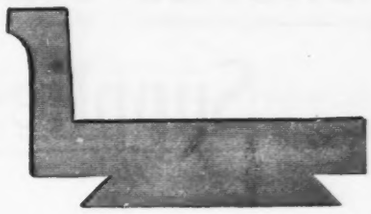

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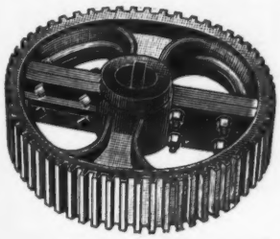

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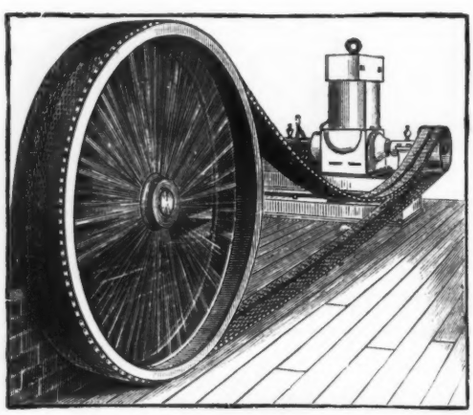

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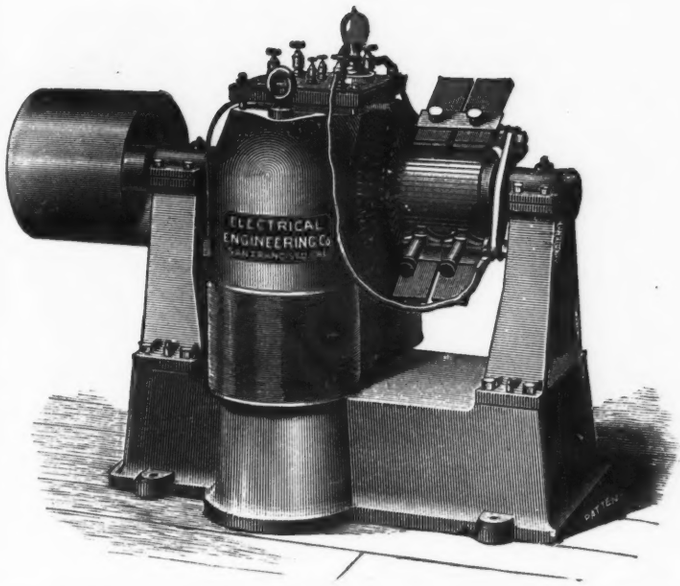

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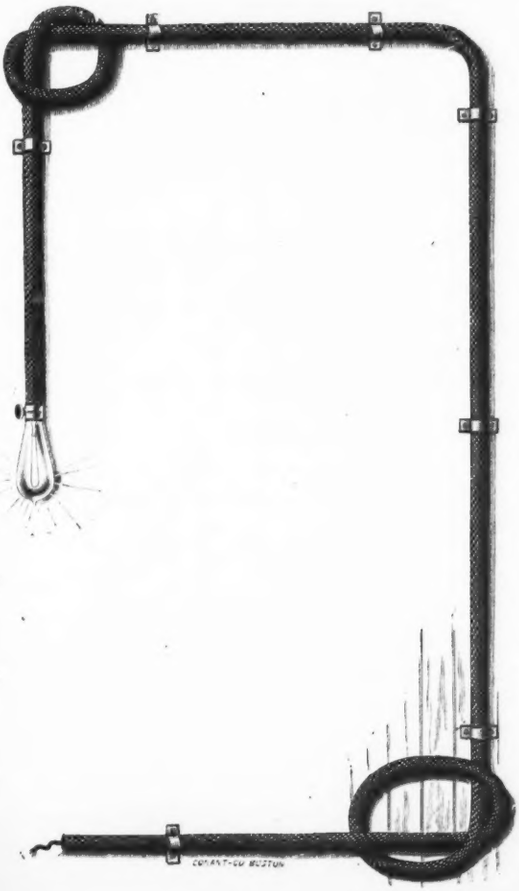

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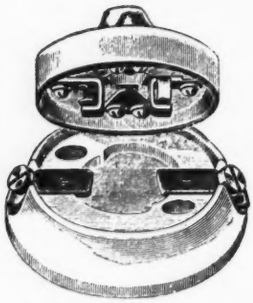

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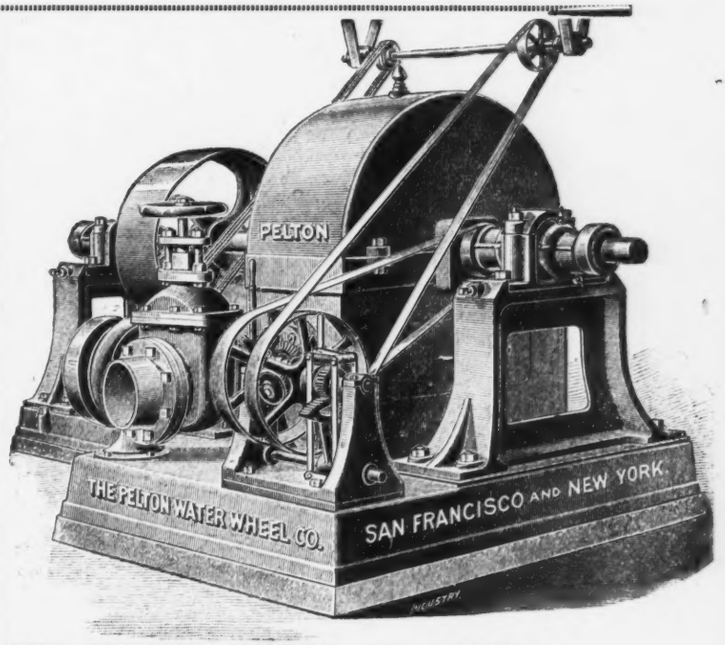

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